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WORLD OIL

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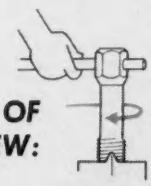
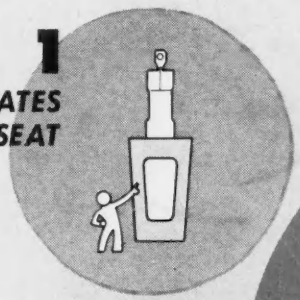
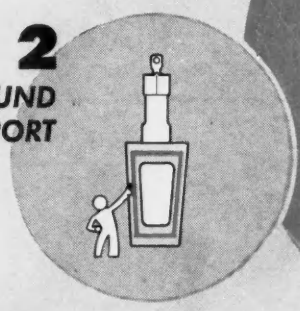


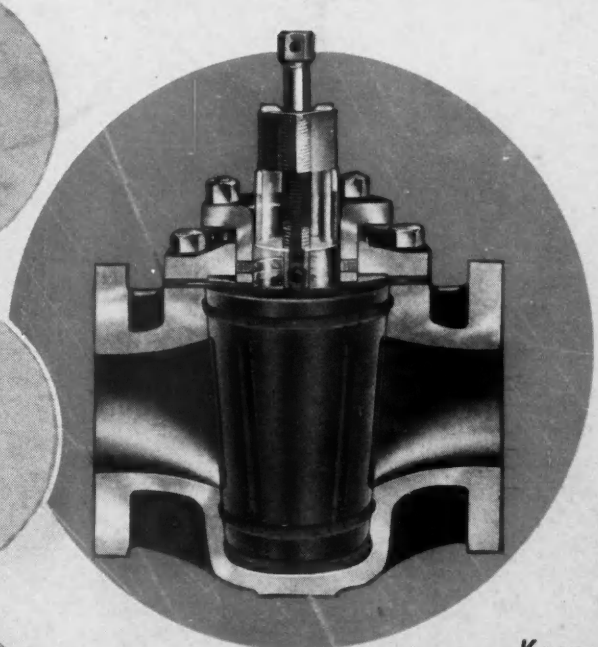
1 *LUBRICATES SEAT*



2 *SEALS AROUND EACH PORT*



3 *JACKS PLUG*



The lubricant within the Nordstrom valve carries multiple responsibilities. It plays a vital part in the perfect performance of the valve. When you turn the screw of a Nordstrom valve, Nordcoseal supplies the protected seat with lubricant, applies a pressurized seal around each port and, if necessary, will jack the plug if it is too tight.

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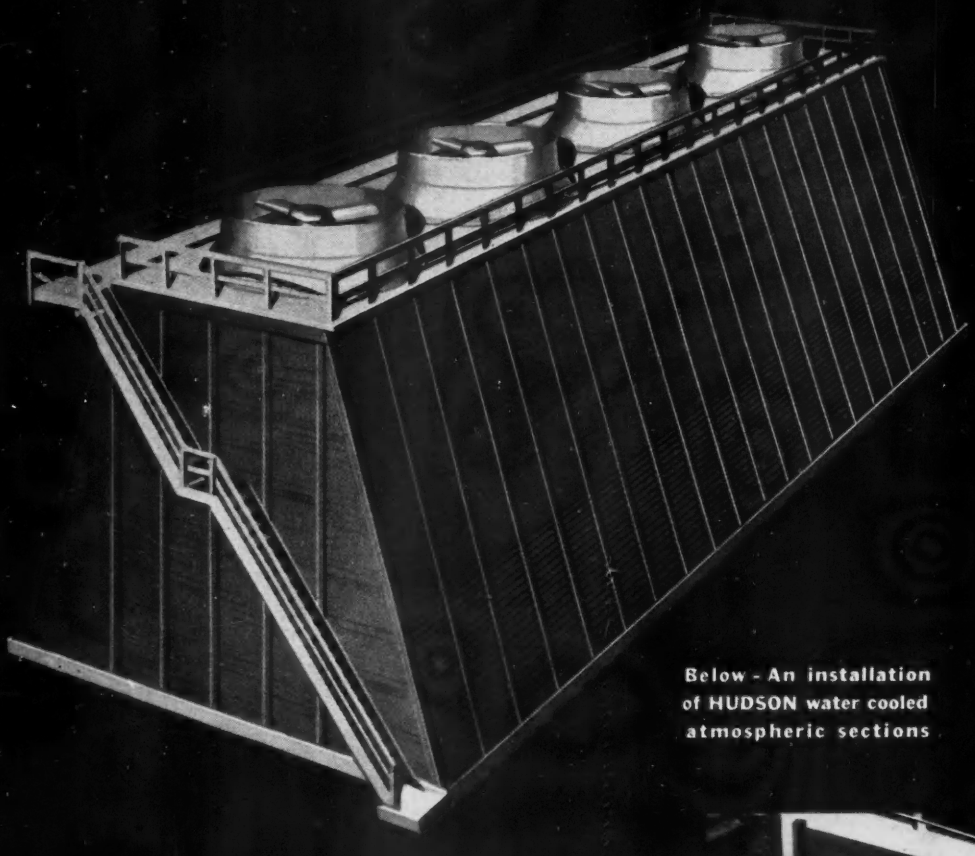

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for the refining-natural gasoline industry

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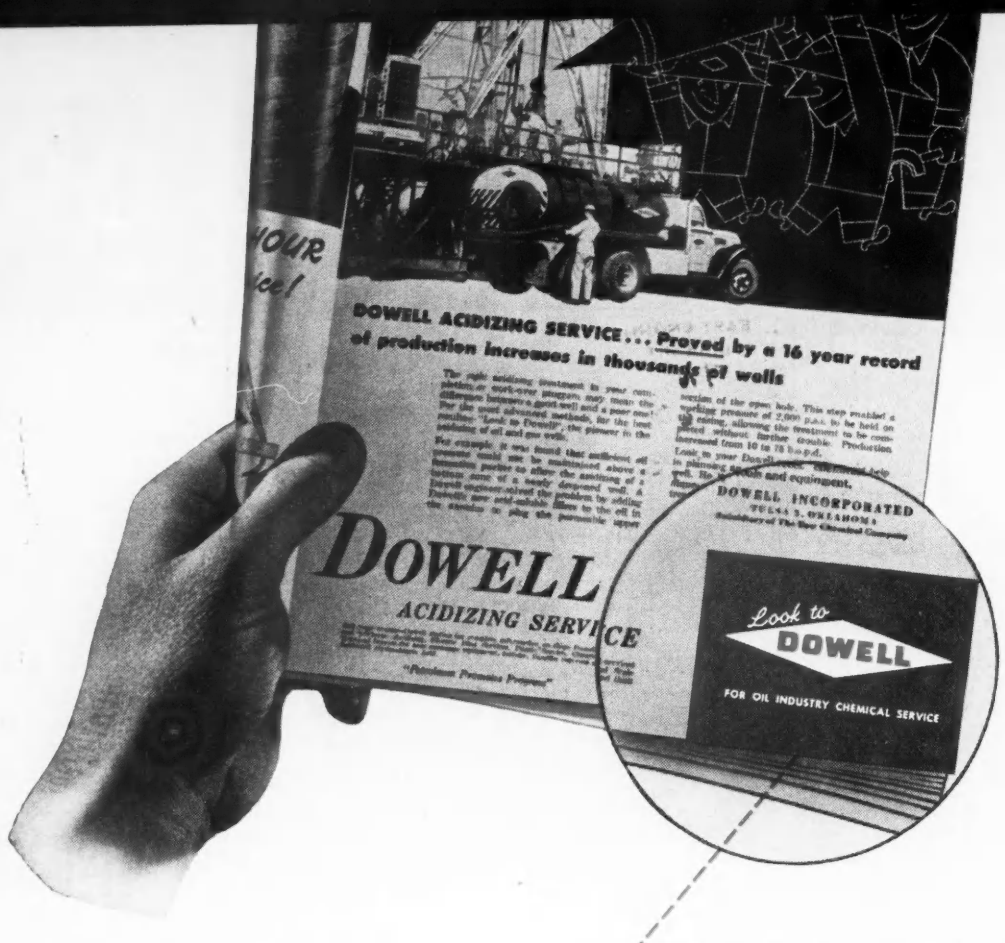
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Publisher's Page

THE OIL SITUATION

PRICE CUTS on lower than 30-gravity crudes in Texas and Mississippi are not likely to be extended to other grades of oil, it appeared as April closed. It looks as though the storm has been weathered, at least for some time.

As a whole, the situation seems to be in better shape now than a month ago. The April price cuts in Texas and Mississippi were not too important, being very local and affecting only six fields producing less than 70,000 barrels per day of heavy asphaltic base oils. There was a possibility pending of heavy oil cuts in other areas.

Sweet oils continue increasingly short, and prospects for heavy gasoline demand are good. "If you have 500 to 1000 barrels a day of East Texas crude, I can get you a 10-cent premium," a friend said to us. We didn't have it!

The demand, and consequently price situation, of residual burning oils, some distillates and kerosine, as well as lubricants, is causing concern, the heavy oil crude cut having been occasioned by weakened market on the burning oils. There is a lot of talk that refiners have over-built on lube plants and that lube oil prices may be reduced. All these things, plus cuts in Venezuelan and Persian Gulf oil, cause some to interpose a word of caution.

When the cuts on heavy oils were announced late in April some producers feared they might extend to the sour crudes of West Texas and elsewhere. There has been some worry about increasing stocks of sour crudes, but our information is that the situation is in better shape, although stocks of sour crudes have increased disproportionately as compared with sweet oil.

Texas allowables were reduced for May, but Oklahoma did not make a reduction for May and Louisiana increased its allowables somewhat.

There seems a definite feeling that beginning with June there will be increases on Texas allowables. Demand is shaping up to make such a procedure a necessity.

Stocks of crude oil, which had been climbing since the first of the year, are not too excessive yet, in the opinion of a number of major companies who were queried on this at the Texas Railroad Commission hearing in Houston in April. The Commission had asked the large companies their opinion on "adequate stocks." The majority thought crude stocks should range from 250 million barrels to 270 million barrels. We had, at the last report, 269 million. A little on the high side but not excessive. Majority of those queried thought gasoline stocks April 1, beginning of the heavy-consuming period, should be 125 million barrels. We had 127 million barrels. Majority thought that gasoline stocks October 1 should be 90 to 95 million barrels although one thought it should be 110 million.

There is a lack of balance on sour crudes. Nearly half the additions to crude oil during the first 3½ months of this year were of West Texas oil, much of it sour crude. Some companies are long on it, others are short, and are buying from the long ones.

The import situation, from the standpoint of the domestic producer, is improving. In January and February of this year imports of crude oil ran 474,000 and 450,000 per day. At the Railroad Commission meeting mentioned above, major importers reported their May crude oil imports would be 346,800 barrels per day and June imports would be 326,000 barrels per day. In 1948 the imports for the two months were very little more than those proposed for May and June this year.

Had imports not been reduced domestic crude production unquestionably would have been cut even more than it was, or stocks would have climbed to heights dangerous to the stability of the industry.

But the import situation, as reported to the Railroad Commission, sounds a warning bell. One large domestic producing and refining company told the commission it was forced to import 4000 barrels per day of sweet crude from abroad because it could not get what it needs domestically.

Texas is the state where most drastic reductions in allowables have been made. Texas Railroad Commission seems to be committed to a plan of reducing or raising allowables "across the board" without too much regard to the demand for certain types of crude. Regardless of the fairness or unfairness of such a policy it affords possibilities of being carried to an extreme with consequent bad results. We hope that the commission is watching closely the overall effects of such a policy.

All in all, the general situation in the production branch of the industry seems good. Reductions in exploratory work which would have followed general price cuts have not come and the industry seems to be in position to carry on its work spending large sums in search for more oil, as well as to take care of unprecedented demand for gasoline for the country at large.

The foregoing represents the short range prospects for the next several months, possibly until the end of the year.

But there are some who think that there has been a "turnabout" in the visible supply of oil, domestically and abroad, which must be taken into consideration in the long range prospect. Potential production has been built up to a high point in several countries abroad, and at least one country, Canada, which has been an importer of crude, may switch to the export status within the next few years.

Certainly there is food for thought in the fact that some domestic oils are highly desired and that some crudes require additional cost in processing. Some companies have made switches this year in their drilling plans, moving rigs out of heavy oil areas into light and sweet oil areas. We may see exploratory drilling in sour crude areas adversely affected. Operators still have a selectivity as to where they explore for oil. All of us will watch this trend most carefully.

Ray L. Dudley

Protect THOSE LOW-PRESSURE ZONES FROM CEMENT CONTAMINATION

The difficult problem of cementing a string of casing at a predetermined point above the bottom of the hole, while protecting a permeable, low-pressure zone below from cement contamination is successfully being solved by using Baker Triplex Cementing Equipment.

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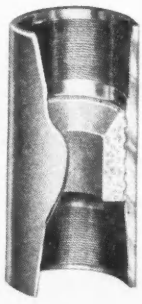
With the Baker Triplex Cementing Shoe (Product No. 136) all cement slurry is directed upward through side whirler ports of the shoe, and a back-pressure valve prevents any return flow of the slurry. The Baker Metal Petal Basket forms a bridge even in large diameter holes; readily conforms to hole irregularities over a wide range of diameters; and prevents the cement slurry from settling in permeable, low-pressure zones below. A Baker Model "G" Casing Centralizer, positioned just above the Triplex Shoe, assists in perfect cementing performance.

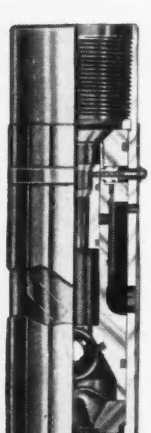
ACCESSORY EQUIPMENT OPTIONAL

When it is desired to retain cement tailings inside the casing (thus preventing dilution of the cement slurry around and above the Triplex Shoe) either of two collars may be used, *as illustrated below:*



Baker Triplex Cement Baffle Collar (Product No. 137) is used when a stop for the cementing plug is desired, to retain cement tailings inside the casing.

Baker Triplex Flapper Valve Float Collar (Product No. 134 M&F) provides the safety of an additional float valve, as well as a stop for the cementing plug.



Baker Triplex Cementing Shoe, Product No. 136. Named "Triplex" because it performs a "triple" service: (1) is an efficient float shoe for running-in the casing; (2) whirls the cement slurry upward to minimize danger of channeling; (3) Metal Petal Basket expands to form a bridge which prevents cement contamination of low-pressure zones below.

HERE'S HOW *Triplex* BRINGS YOU "BAKERESULTS"

Ⓐ Baker Triplex Cement Baffle Collar, installed a joint or two above the shoe, serves as a stop for the cementing plug. Ⓑ A hold-down strap retains Baker Metal Petal Basket against the "TRIPLEX" Shoe while running-in. Ⓒ Cementing Ports are covered by Tripping Valve until cementing is commenced. Ⓔ After reaching the desired point in the hole, circulation is established through central passageway. A Tripping Ball is pumped down the hole to seat upon the Tripping Valve. Pressure is applied to shear the Tripping Valve shear screws and force the Tripping Valve downward to expose the cementing ports. Ⓕ Shearing these screws also releases the Basket hold-down strap and allows the Metal Petal Basket to expand against the walls of the hole. Ⓓ A resilient rubber, sleeve-type, back-pressure valve opens readily (see dotted white line) to permit passage of slurry into annulus above. Cementing then is carried out in conventional manner with cement slurry directed upward by the exclusive Baker "Whirling" action. Only readily drillable materials are used for all internal parts.—Look in your BAKER (or Composite) CATALOG, or write to BAKER OIL TOOLS, INC., at Houston, Los Angeles, or New York for complete information.

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BAKER *Triplex* CEMENTING EQUIPMENT

The Changing Panorama

A Farewell to Ross Sterling

By RAY L. DUDLEY, Publisher

THE DEATH on March 25 of Ross Shaw Sterling, president of Sterling Oil & Refining Company, and one of the founders of the Humble Oil & Refining Company, has removed still another of the colorful pioneers in Southwestern oil.

It is difficult to write of him impersonally because he was such a close friend. The early days of this publication, and of the Humble Oil & Refining Company, then a great independent oil company, coincided and we had much in common. At that time Mr. Sterling was president of Humble. In fact, he was one of the founders of the Humble Oil Company which was the forebear of the present Humble Oil & Refining Company. Later he became chairman of the board and then retired to his other businesses, which were numerous. He was extensively interested in rice, in banking, in irrigation (one day he confided to us that he had grubstaked someone and as a result held an interest in a profitable gold mine). At one time he was a heavy owner of real estate in Houston, and principal owner of the morning paper in Houston.

He then became interested in politics, was appointed chairman of the Texas Highway Commission, and did such a fine job that he was elected governor. Then came the dark days of the depression, with Governor Sterling giving all his attention to affairs of the state. His personal interests suffered acutely and he lost much of what he had accumulated. It was during the depression that he started a comeback, through the organization of Sterling Oil & Refining Company. His new company had the well wishes of a host of friends and was very successful in developing production.

But it was for Ross Sterling the man, rather than the oil man, the business man, the statesman, that he was held in greatest affection by his friends. He was generous to a fault. No one but Ross Sterling, and possibly his widow, will ever know numberless instances of where he helped young people, because he had little to say about what he had done. But we know of many, because we were closely associated with him in some of his business enterprises, and we ourselves are proud to say that Ross Sterling helped us once when help was desperately needed.

His life was filled with service to his fellow man. He was for years connected with the Houston Port Commission, and at his death was chairman of the Board of the Hermann Hospital Estate, a charitable institution which is heavily engaged in the operation of hospitals in Houston.

We shall miss him, and so will many another person who knew him and loved him.

Same Prices Reflect Market Competition

PRICES OF petroleum products are cited as evidence of active competition in an article in the *Harvard Business Review* of March entitled "Dynamic Competition." The article concludes that when identical prices occur as a part of a moving price pattern of an industry, it is proof of market competition rather than of collusion. Authors are Raymond Rodgers, professor of banking at New York University, and H. E. Luedicke, executive editor of the *New York Journal of Commerce*.

They studied prices of heavy (No. 6) fuel oil, light (No. 2) fuel oil, and gasoline in the New York area for 1947 and 1948, when the markets changed from beginning to peak of a sellers' market and back to over-supply and a buyers' market. They found "strong evidence of keen but varying competition in the sale of major refined petroleum products." They also found, significantly, that prices tended toward uniformity more under keener competition than when tight supplies made ready markets.

The authors reasoned that (1) when supplies are tight, such factors as cost differences and individual administrative policy come into play and cause the spread between prices of individual sellers to widen; and (2) when supplies are ample, such spreads disappear because competitive selling in a buyers' market demands that all sellers meet the lowest market price, unless they want to lose sales volume rapidly.

Fixing of Gas Prices Might Bring Controls

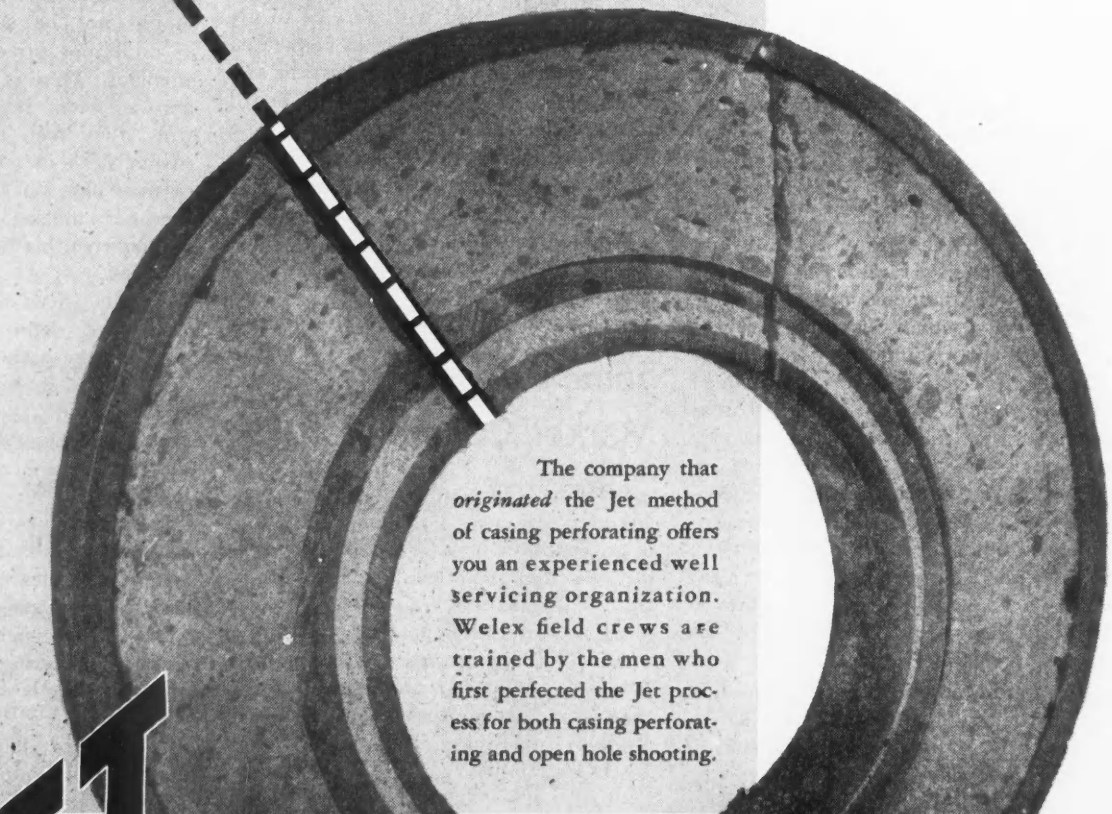
ALTHOUGH HIGHER well head prices of natural gas are essential, many producers are convinced that they should not be sought through fixing of minimum prices by state or federal agencies. That is an unwise and dangerous way, inviting unwanted controls, they feel, and the better way is to put faith in free enterprise, building of new pipe lines, opening of new and stronger markets, and the inevitable competitive bidding of purchasers for supplies.

Better prices for natural gas at the wells are definitely needed in many areas. More attractive prices would reduce waste and thus be an important conservation factor. They also would make gas reserves more valuable and desirable and encourage exploration and development.

Some producers therefore are in favor of state laws authorizing state conservation agencies to fix minimum prices paid to producers for gas. Several states already have such laws and others have been considering their enactment, although there is doubt about the validity of these laws.

There are dangers for producers in fixing of minimum prices of gas even by state agencies. Some of these were pointed out by Guy I. Warren, president of the Texas Independent Producers & Royalty Owners' Association at the annual meeting in Houston. If the states fix the price of gas sold within their borders, he warned, then the federal government certainly will follow suit and fix the price of gas produced for interstate shipment. "This sort of legislation is a one-way ticket to federal control of the production of gas," he continued, "and it is well to consider the fact that the agency empowered to raise the price is also empowered to lower it; and the agency, whether state or federal, which has the price fixing power is more susceptible to the voice of the consuming public than it is to the producers and royalty owners who have gas to sell."

How to Perforate Casing for DEEPER PENETRATION and INCREASED OIL FLOW



The company that *originated* the Jet method of casing perforating offers you an experienced well servicing organization. Welex field crews are trained by the men who first perfected the Jet process for both casing perforating and open hole shooting.

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Monthly News Analysis

SUPPLY-DEMAND SITUATION IMPROVED . . . MORE STEEL GOODS AVAILABLE NOW
FREEDOM FOR GAS PRODUCERS SOUGHT . . . CO-OPS HAVE 1700 PRODUCING WELLS

Lower Imports and Crude Output Improve Situation

Reductions of imports as well as domestic production already have brought the industry into a favorable position as regards supply and demand relationships. In May the position should be improved even more, as the month will bring further reduction of crude oil imports and domestic production around or slightly under the low rates of April, as indicated by the 50,000 barrels per day cut in Texas allowables May 1.

In view of a favorable situation on stocks of crude and products and good demand for oils, it is strongly indicated that domestic crude production and refinery runs will need to be stepped up in June and subsequent months. With production and refinery runs for April and May lower than in any month of 1948, supply will have to be increased even to meet the same demand as last year, and even the most conservative forecasts are anticipating that total demand will be 3 to 5 percent larger in 1949 than in 1948.

In the downward adjustment of supply which has been found necessary, imports have been reduced and will be curtailed further. Crude oil imports averaged 448,000 barrels daily in January 1949 but were down to about 374,000 daily in February and 396,000 daily in March. In May they will be down to about 350,000 barrels per day and in June to about 325,000 daily, it is indicated by data furnished by importing companies to the Texas Railroad Commission. For the whole year 1948 crude oil imports averaged 353,000 barrels daily.

Stocks of Crude and Gasoline Satisfactory

U. S. stocks of both crude oil and gasoline are ample but not seriously excessive. This view was expressed almost unanimously by representatives of over a dozen of the larger companies at the statewide proration hearing of the Texas Railroad Commission at Houston April 19.

Actual crude stocks as of April 1 totaled about 268 million barrels. Considering views of all the witnesses at the hearing, it is indicated that crude stocks, properly distributed, would be adequate but not excessive within a range of 250 to 275 million barrels. Only a few witnesses mentioned figures slightly outside that range. One witness said stocks of 260 million would be sufficent, a reduction of about 8 million from existing levels, if the change were effected by eliminating an excess of 17 million barrels of sour crude and adding about 10 million barrels of sweet crude to storage. Another witness said a reduction of crude stocks from 268 to 250 million barrels would leave an adequate inventory if the reduction were made by eliminating certain surpluses, including approximately 7 million barrels in West Texas, 4 million in Wyoming, 3 million in Illinois, 2 million in Oklahoma, and 2 million of foreign crude. It was generally agreed, however, that existing crude stocks were not economically burdensome, with the possible exception of West Texas sour crude.

Stocks of finished and unfinished gasoline stood on April 1 at 128 million barrels. At the Texas hearing virtually all witnesses estimated the proper level as of April 1 within a range of 120 to 128 million barrels and the average of the estimates was around 125 million. No witness considered existing stocks as seriously excessive or conducive to waste. These stocks should be brought down by October 1 within a range of 85 to 95 million barrels, it is indicated by most of the opinions expressed at the hearing, only a few of the witnesses having mentioned figures below or above this range.

The Railroad Commission had requested that these views be presented in order to help make certain that ample supplies of crude oil and products will continue to be available

Gasoline Demand Large Factor in Crude Market

Like the nation's economy in general, the petroleum industry is undergoing an adjustment to more normal supply and demand relationship. The adjustment for the industry appears to be fairly well completed, barring a more serious business recession than that which has developed so far. Consequently, producers' hopes that crude prices generally will hold to existing levels have been bolstered, although the possibility of a moderate general crude price reduction cannot be ruled out.

Whether or not crude prices hold unchanged will depend greatly on the gasoline market. So far, gasoline prices have held up well, but there have been reports of lowering quotations to commercial accounts, and in some cities there has been retail price cutting. Gasoline stocks are not materially excessive, but they are generally considered quite ample. If demand should fail to come up to expectations, the stocks situation naturally would put downward pressure on prices in efforts to avoid surplus and wasteful stocks. Gasoline inventories were at record levels as the heavy consuming season opened, in anticipation of a substantial increase in demand in 1949, and prevailing prices reflect expectations of strong demand and ample supply. Any threat to prices lies in the fact that ample supply is assured but demand equal to the supply is less certain.

Since gasoline is the industry's primary product, it largely determines the market for crude oil, and the importance of gasoline prices to the crude market is now accentuated by the fact that prices of both light and heavy fuel oils have been reduced. For distillate fuel oil, including heating oil and diesel oil, early spring brought price reductions of ½ to 1 cent per gallon. Residual fuel oil prices have been reduced sharply—more than $1 a barrel on the East Coast. In California residual fuel oil and heavy grades of crude oil were cut again in April after having been reduced in January. For the lowest gravity listing, 12 gravity, the crude price was cut 30 cents in January and 40 cents in April, a total reduction of 70 cents. For grades above that, reductions were smaller, affecting only crudes below 25 gravity in the January revision and crudes below 20 gravity in the April revision. In California, residual fuel oil was lowered in price by 25 cents a barrel in January and 20 cents in April. In East Central Texas on April 25 Humble Oil & Refining Company initiated a reduction of 25 cents a barrel for crude in the Hawkins, Talco, and Sand Flat fields, where it is the principal producer. The company explained that these are low gravity

crudes with high yields of fuel oil and that it was "necessary to bring prices more nearly in line with the lower values of these crudes to refineries because of the sharp decline in fuel oil prices brought about by changed supply and demand conditions in recent months." The new prices range from $2.15 per barrel for 29-gravity and above to $1.95 a barrel for oil below 20 gravity.

The sharpest decline in crude prices has been that for Pennsylvania grade. Bradford-Allegany crude was further reduced 15 cents April 13 to $3.40 a barrel. This was the sixth reduction within 4 months, the price having held at the postwar high of $5.50 a barrel from December 1, 1947, to December 11, 1948, when a decline started with a 50 cent cut. This crude has dropped $1.60 a barrel or 32 percent and is now close to the levels where prices were frozen under OPA. In 1941 before price control the Bradford posting varied between $2.30 and $2.98 a barrel. The recent further cut was attributed to continued accumulation of stocks of Pennsylvania grade, but there are many reports of improving demand for Pennsylvania grade lubricating oils.

Supply of Oil Industry Steel Goods Improved

Supplies of steel goods for petroleum industry use have materially improved in recent months and are sufficient for demand in the case of most products except line pipe.

Most of the groups that were seeking allocations programs for steel for oil industry items have withdrawn their requests which were filed with the Commerce Department's Office of Industry Cooperation.

Demand for line pipe has remained a problem, and in studying requirements, the Department of Commerce is considering data from the Federal Power Commission on pipe line authorizations and reports from the American Gas Association; and recently revised data from the steel requirements committee of the National Petroleum Council will be similarly taken into consideration.

Premium price producers in the steel industry have been cutting their quotations down to a competitive level. U. S. Steel announced last month its second cut in two weeks in galvanized steel, and National Tube dropped galvanized pipe prices by $2 a ton. This is also the second recent cut by National Tube.

Improvement of supply of steel products has been achieved with regard to foreign as well as domestic requirements of U. S. oil companies.

In view of the better supply the Commerce Department, which has power to control exports, has been reviewing export license applications affecting refinery equipment, especially proposed shipments to western Europe. These applications involve equipment that would be purchased with dollars already held by the countries concerned and would not be financed through the Economic Cooperation Administration.

Heating Oil Business Is Increasingly Competitive

Confident of the ability to provide ample supplies of fuel oils in the future, oil companies are now resorting to traditional selling and competition for heating oil business. While prices have been reduced, companies also are giving assurance that shortages are over and are advertising that oil is a clean and economical fuel for heating the home.

Standard Oil Company (Ohio), for example, is offering free a booklet on fuel oil for home heating and has experts available to help householders plan heating facilities for new or older homes.

For producers of crude oil, the active efforts to build up heating oil business are significant and encouraging. Demand for crude may be materially increased through stimulation of oil-burner installations.

Krug Says Domestic Oil Nation's Safest Supply

The U. S. must rely more strongly on developing its own petroleum resources than on any import program, is the warning of Interior Secretary J. A. Krug in his annual report submitted to President Truman. Krug points out that "reliance on foreign sources—particularly sources half way around the world—is dangerous," despite the fact that it might be cheaper to use "some foreign (or imported oil) than to develop some of our more expensive sources and substitutes."

Krug stressed that further development of our national resources is desirable, adding: "There remain great areas in the U. S. that have not yet been explored completely for oil. New fields or deeper productive horizons continue to be found by more extensive exploration even in areas that have been carefully combed for years. No producing region in the U. S. has been so thoroughly explored that new deposits may not be found in it."

Much of our additional domestic supply since the war has come from intensive development drilling and the increase of production allowables in oil fields which had previously been discovered during the past two decades, Krug said.

"We need to develop and apply the techniques for recovering oil left in the ground in the older fields," he continued. "We need to spend more money in geologic surveys to find oil and to explore the resources in the sedimentary basin of Arctic Alaska and the submerged lands of the continental shelf off the coasts."

Krug said that most geologists estimate there are "many billion barrels of oil and trillions of cubic feet of natural gas" recoverable from the 760,000 square miles of the continental shelf.

He reemphasized his program for the development of a synthetics oil industry from coal, natural gas and shale. "Our shale is not being used for anything else," he said. From the natural reserve standpoint, it is the most logical substitute for our limited supply of petroleum.

"It has been estimated that we can recover several billion barrels of oil from our vast, unused shale deposits. It may ultimately be cheaper to produce shale oil than petroleum, counting all the increasing costs of new petroleum exploration and production. Our natural gas supplies are almost as short as our petroleum, and so gas is not a long-range substitute."

Krug said that the synthetics program should be pushed even if it requires government financing, "although private industry is showing increasing interest in it."

Freedom for Producers Sought in Gas Bills

Four bills have been introduced into Congress with the general purpose of explicitly exempting the small, independent natural gas producer from the jurisdiction of the Federal Power Commission. Initial hearings before the House Interstate and Foreign Commerce Committee brought out the fact that hundreds of small natural gas producers and gatherers were now discouraged from expanding their efforts because of the ambiguity of the Natural Gas Act and the uncertain policy of the FPC.

One of the bills was introduced by Rep. John E. Lyle of Texas who testified that he knew of 50 fields in Texas shut in because the gas producers there were afraid to enter into contracts with transmission companies until the law is clarified. The result, he said, is the wasteful flaring of gas, draining of gas reserves, failure of royalty owners to benefit from the resources underlying their lands.

The current measures follow the defeat of the Moore-Rizley Bill in the last Congress. It was defeated in the Senate after approval by the House. One of the four new bills was introduced by Sena-

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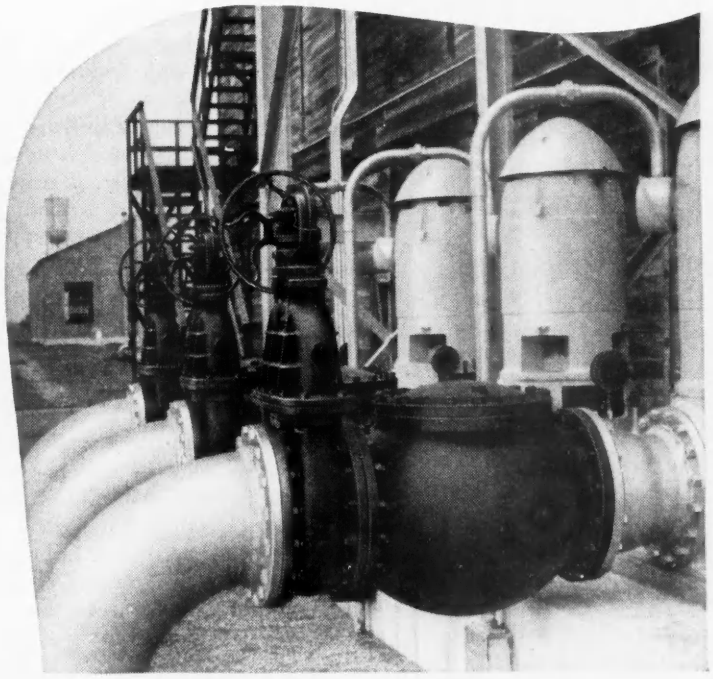

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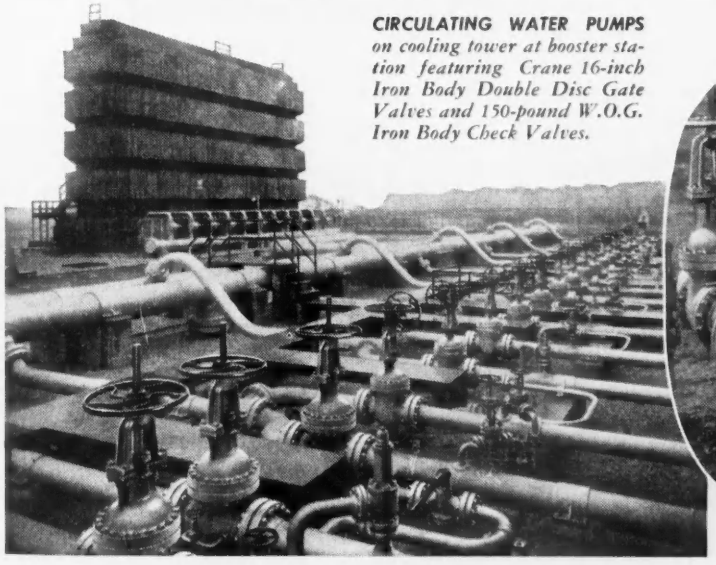

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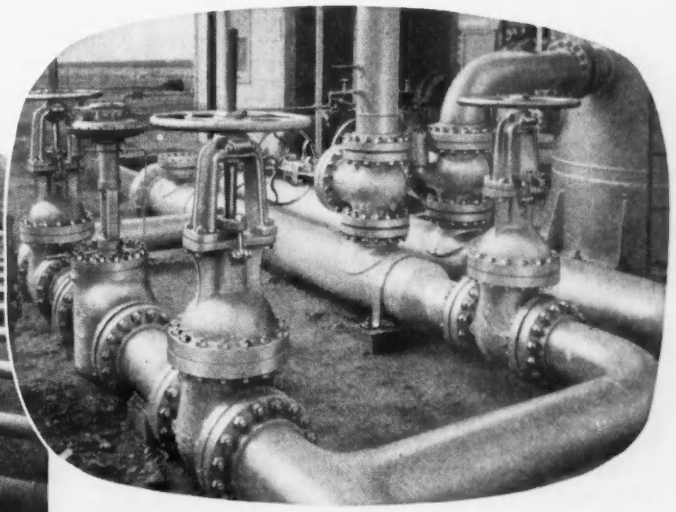

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tor Elmer Thomas (Dem., Okla) and Robert S. Kerr (Dem., Okla) to remove from FPC jurisdiction those independent gas producers who sell to interstate pipe lines. It is likely that all the various bills will be rewritten into a new measure which will receive speedy approval of the House. It is reported that FPC members themselves will not oppose the objective sought.

Suit Contends Fixing Of Gas Prices Illegal

The right of the Kansas Corporation Commission to fix at 8 cents per thousand cubic feet the price paid for gas at the wells in the Hugoton field has been challenged by Cities Service Gas Company in U. S. District Court at Topeka. The commission had issued an interim order fixing that minimum price, pending further investigation and its final order. Royalty owners and others had sought the fixing of a minimum price.

In its suit, Cities Service protests that Kansas law does not give the commission power to fix gas prices; that the commission's action interferes with interstate commerce; that the order is an illegal restriction and compulsion on the Federal Power Commission; and that it deprives the company of property without due process of law.

Revisions Made in Oil For Security Report

The so-called "Pratt Report" to the National Security Resources Board, submitted last fall, has been completely rewritten in order to remove industry objections to the previous draft. Among the objectionable features now removed from the report are:

The proposal to cap back 20 percent of all reserves as underground storage for possible military use.

The suggestion that another war would find the U. S. short of petroleum products to the amount of 2 million barrels a day.

Proposal that the government enter into commercial-scale production of synthetic fuels.

The current revised document is still top-secret and is now in the hands of Presidential Adviser Steelman. It is said to incorporate a number of suggestions of Gen. Ernest O. Thompson, Texas Railroad Commission member, and was prepared by a four-man drafting committee after consultations with State, Commerce and Agriculture Departments, the Oil & Gas division of the Interior Department, Armed Services Petroleum Board, Joint Chiefs of Staff, and several federal bureaus.

Co-Ops' Holdings Include 1700 Wells, 20 Refineries

U. S. co-ops have substantial interests in all divisions of the oil industry, revealed Howard A. Cowden, president of Consumers Cooperative Association, largest U. S. oil co-op. The nation's co-ops own more than 1700 producing oil wells, hundreds of thousands of acres of proved and semi-proved oil reserves, 20 refineries with capacity of 141,400 barrels of crude oil a day, several thousand miles of pipe lines, river barges, finished products pipe lines, terminal storage facilities, warehouses, lube oil and grease compounding plants, gasoline transports, tankwagons, bulk plants, service stations, and wholesaling and retailing organizations, he said.

State Department's Oil Division Is Criticized

The Petroleum division of the Department of State may be abolished this year. The Hoover report for streamlining the administrative setup provides some basis for the prediction, and it is known that elimination of the division was considered two years ago. Generally throughout the industry the Petroleum division has received scant praise on two grounds: it was never staffed with industry representatives or industry-trained personnel, and it follows a policy of cautious and often secret functioning which has tended to place it on a level removed from the operating problems of the industry even in the foreign field.

Oil and Gas Division May Be More Political

There is rising fear in the petroleum industry that the Interior Department's Oil & Gas division is going to become "political." Since the creation of the division in May, 1946, it has been regarded as one of the least "bureaucratic" agencies in government, staffed with industry help and maintaining close contact with the industry everywhere. This policy was largely defined by the division's director, Max W. Ball, who recently resigned. President Truman has announced that for Ball's successor the White House wants a man "who doesn't have too much of a stake in the oil business." This indicates there may be a thoroughgoing change in the character of the division shortly.

Directorship of the division has been offered to at least four well established industry men, B. A. Hardey, W. W. Vandeveer, J. R. Parten and Ralph Zook. None felt he could afford to make the business sacrifice involved in accepting the government post. The National Petroleum Council in its capacity as advisory body to Secretary Krug has sought an industry nominee but without success. Since Ball's resignation the division has been headed by Robert Friedman, a lawyer, who likewise has refused the permanent appointment.

In view of the inability of industry to find an appointee, many observers note that Krug has become impatient, and the Secretary may turn to a non-industry person. It is also known that other agencies of government have criticized the Oil & Gas division because it worked too closely with industry — a policy which the division itself considers non-criticizable. It is generally believed that if present acting director Friedman resigns and if NPC is unable to supply further nominations for the directorship, a chief will be named without further consultation with industry.

Delay Is Indicated In Tidelands Issue

An all-summer delay is expected in the tidelands issue during which time some compromise may be effected between the Truman administration forces and the states. Attorney General Tom Clark now believes that the Supreme Court will not act until next October on the Texas and Louisiana case before it. The interim will be used for the seeking of a compromise formula, with the possibility that Senator Robert Kerr (Dem., Okla.) will act as "peace-maker" between the factions.

One proposed compromise which has been discussed considerably is that state title be confirmed to those underseas lands historically considered within the state boundary. This is three miles from shore for all states except Texas where it is 10½ miles from shore. If this were recognized, then the suggestion is that the federal government be given clear jurisdiction beyond these limits.

The suggested compromise also proposes that within the state boundaries, as defined above, undersea land royalties would be divided 62½ percent to the states, and 37½ percent to the federal government, with these royalty percentages reversed outside the state limits. Existing leases would be confirmed.

Attorney General Clark has acknowledged that supporters of Texas claims are proposing legislation compromising the issue. He indicated that the administration will firmly claim title for the federal government, but that it might agree to let coastal states share substantially in oil royalties and other revenue from their offshore lands and to have representatives on boards administering tidelands oil development.

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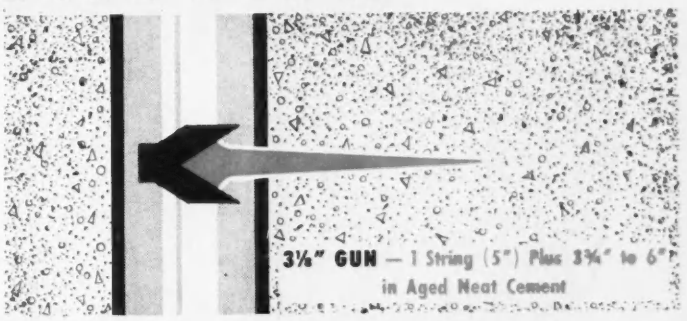

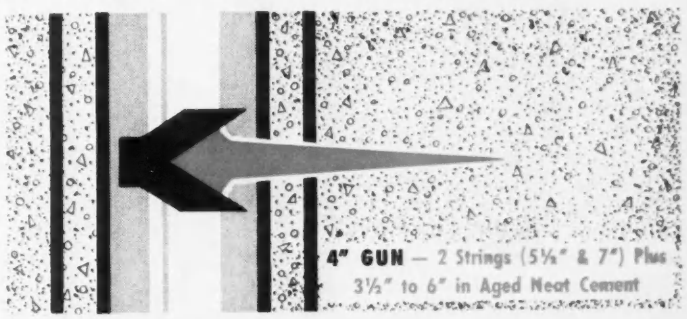

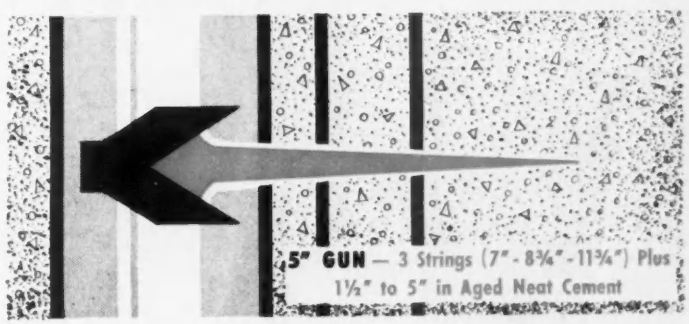

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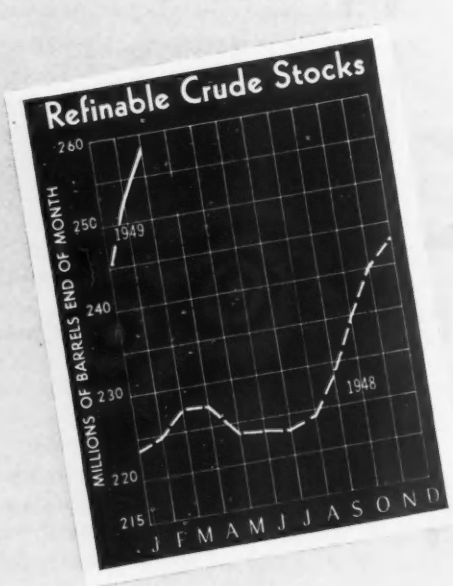


Crude Stocks Continue to Rise

By CECIL SMITH,

MARCH was the third consecutive month in which crude producing and refining rates were reduced. Despite these cutbacks, crude stocks continued to rise and gasoline inventories advanced to the highest level in history. However, crude production was being further reduced during April as were refinery runs to stills in an effort to prevent stocks from becoming burdensome.

Although gasoline stocks are at their highest level they are not generally considered excessive, but nevertheless the industry welcomed the start of the withdrawal season that appeared on schedule early in April. The on-time start of the heavy motoring season coupled with the increase in gasoline demand expected this summer will probably prove that current motor fuel stocks are not too far out of line.

Further reductions in crude production allowable by leading producing states will lower April's output to slightly more than 4,900,000 barrels daily. That will be the first time since April, 1947, that daily output has fallen below the 5 million barrels level. Daily production in March averaged 5,189,000 barrels daily.

Production prospects for May seem to be about the same as for April. While the Texas Railroad Commission lowered that state's allowable

Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month
1946:									
January	4,625	4,520	223,442	,914	102,394	787	28,990	1,224	34,573
February	4,719	4,651	227,220	1,884	104,836	823	25,511	1,243	34,008
March	4,414	4,661	221,400	1,900	104,161	815	29,922	1,213	32,995
April	4,673	4,663	222,480	1,943	98,744	773	32,064	1,247	35,206
May	4,785	4,794	221,592	2,016	93,960	753	33,385	1,220	38,932
June	4,896	4,836	223,140	2,055	91,971	777	38,824	1,219	41,492
July	4,922	4,856	224,351	2,102	87,778	793	46,439	1,163	45,446
August	4,836	4,856	224,157	2,189	86,745	765	54,068	1,159	48,186
September	4,790	4,839	222,417	2,143	87,021	796	62,019	1,150	54,012
October	4,785	4,736	222,177	2,117	85,952	788	76,780	1,090	55,580
November	4,823	4,684	226,453	2,162	88,587	791	68,145	1,101	52,735
December	4,725	4,789	224,473	2,168	92,742	805	59,912	1,159	47,094
1947:									
January	4,671	4,739	223,848	2,078	99,623	778	48,197	1,174	41,550
February	4,810	4,820	225,121	2,089	103,672	777	36,901	1,228	48,480
March	4,908	4,843	228,981	2,076	105,679	825	31,423	1,222	37,403
April	4,974	4,707	235,710	2,037	101,724	764	30,268	1,148	36,455
May	5,033	4,947	237,768	2,128	95,209	805	34,279	1,204	39,992
June	5,099	5,120	237,278	2,258	89,774	807	39,676	1,233	43,515
July	5,137	5,221	230,974	2,302	86,003	847	46,444	1,244	47,600
August	5,173	5,260	228,523	2,383	85,849	869	54,707	1,245	51,334
September	5,251	5,236	225,258	2,375	84,360	911	59,764	1,237	52,578
October	5,320	5,253	226,666	2,371	82,584	938	63,252	1,260	52,502
November	5,291	5,291	225,462	2,332	87,551	942	61,334	1,245	52,455
December	5,337	5,350	224,929	2,347	92,303	992	51,081	1,282	47,091
1948:									
January	5,283	5,348	223,430	2,328	102,167	1,082	41,036	1,278	44,636
February	5,353	5,380	224,880	2,264	110,999	1,127	34,590	1,295	43,156
March	5,406	5,387	227,408	2,252	111,949	1,050	32,124	1,307	41,945
April	5,484	5,540	227,278	2,396	109,289	978	34,514	1,303	43,301
May	5,502	5,668	223,820	2,486	108,552	992	40,781	1,314	48,518
June	5,544	5,632	223,481	2,529	104,518	998	48,352	1,280	52,465
July	5,522	5,631	223,124	2,494	98,839	994	58,725	1,264	58,431
August	5,577	5,621	224,211	2,532	95,445	1,038	68,818	1,248	64,096
September	5,435	5,376	228,401	2,416	90,518	961	76,320	1,154	68,005
October	5,632	5,594	234,615	2,490	92,426	1,069	82,920	1,268	72,363
November	5,675	5,672	240,083	2,551	95,589	1,081	83,909	1,277	77,033
December	5,688	5,720	246,199	2,626	103,697	1,106	*75,953 †71,381	1,299	*76,942 †63,993
1949:									
January	5,365	5,641	248,175	2,538	116,621	1,063	61,584	1,348	62,508
February	5,392	5,390	252,708	2,468	124,365	1,038	52,109	1,186	59,568
March	5,189	5,384	257,395	2,490	127,860	967	48,604	1,191	58,734
March, 1949: Changes:									
In Month	−203	−6	+4,687	+22	+3,495	−71	−3,505	+5	−834
In One Year	−217	−3	+29,987	+238	+15,911	−83	.....	−116	.....
In Two Years	+281	+541	+28,414	+414	+22,181	+142	.....	−31	.....

* For Comparison with prior months. † For comparison with subsequent months.

Despite Producing, Refining Cuts

Staff Writer

production, some of this drop was offset by an increase in Louisiana's declared rate.

Both crude production and refining are being carried on at lower rates than at the same time last year when the industry was battling to meet demand and to lay in stocks. Now with the stocks situation improved this reduction in production and refining was a means of getting back towards normal operations. However, if this year's petroleum demands live up to expectations it is reasonable to expect about mid-year that production and refining will both be back on the increase.

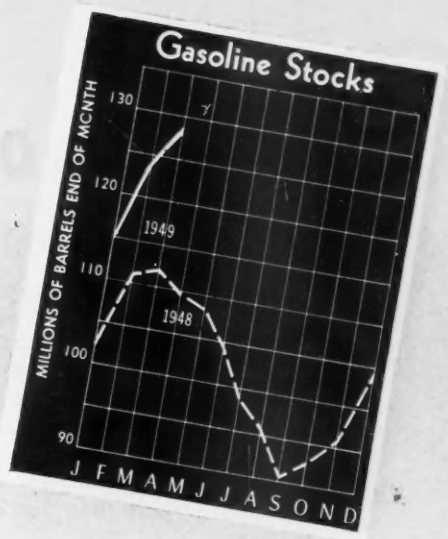
There appears to be no general threat of a crude oil price cut. Supply and demand situation is pretty good, and while demand has not been exactly everything that could be hoped for, lessened production has improved the balance. Crude prices will depend largely on gasoline prices which are at present not absolutely clear. There have been spotty reductions in gasoline prices, but on the other hand there also have been increases. With the gasoline consumption season getting underway as usual without delay the likelihood of a gasoline price break seems materially dimmed.

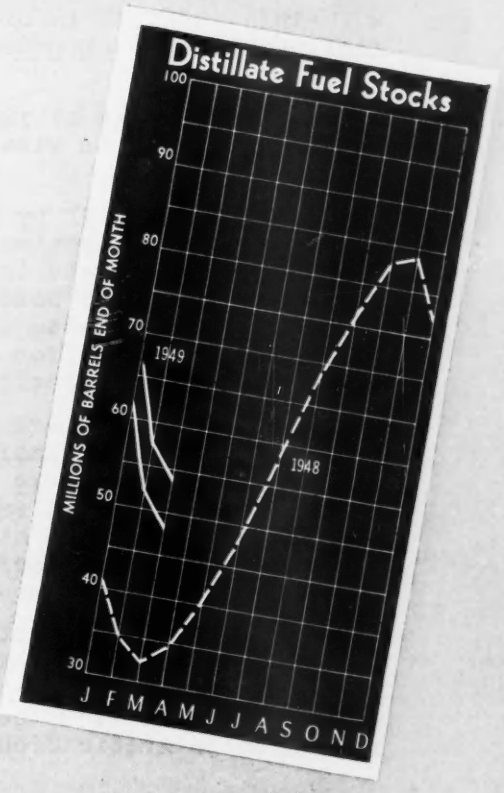
Crude oil production in March amounted to 5,189,000 barrels daily, a drop of 203,000 barrels a day from February's output and 217,000 a day less than was produced in March of last year.

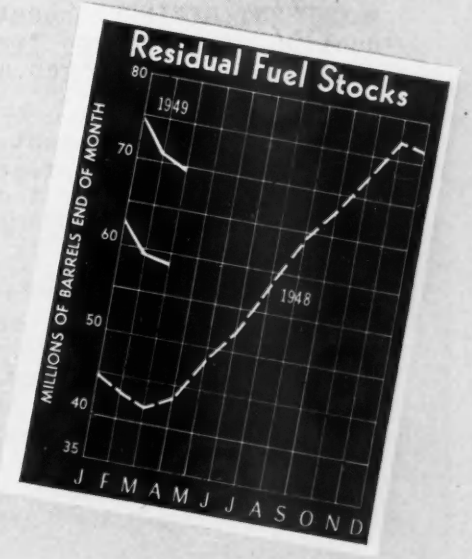
Refinery runs to stills were only slightly changed from the previous month's rate, being 5,384,000 barrels a day in March or 6,000 a day less than February's runs. A year before runs were 3,000 barrels a day more than they were in March.

State Crude Oil Production
(THOUSANDS OF BARRELS)

STATE or DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL FIRST THREE MONTHS		
	March, 1949	Feb., 1949	March, 1948	% Diff. March, '48-'49	1949	1948	% Diff. '48-'49
Alabama	1.2	1.3	1.2	.....	112	113	— 0.9
Arkansas	86.1	88.0	86.7	— 0.7	7,765	7,817	— 0.7
California	953.9	948.5	939.9	+ 1.5	85,312	85,073	+ 0.3
Colorado	63.6	61.9	44.7	+ 42.3	4,968	4,091	+ 21.4
Florida	1.3	1.2	0.8	+ 62.5	112	73	+ 53.4
Illinois	175.0	178.0	174.4	+ 0.3	15,573	15,785	— 1.3
Indiana	22.7	22.8	14.3	+ 58.7	2,008	1,286	+ 56.1
Kansas	292.9	273.4	272.6	+ 7.4	25,531	25,727	— 0.8
Kentucky	23.0	22.7	25.2	— 8.7	2,044	2,195	— 6.9
Louisiana	507.4	522.5	480.1	+ 5.7	46,525	43,264	+ 7.5
North Louisiana	120.7	122.3	115.8	+ 4.2	11,039	10,368	+ 6.5
South Louisiana	386.6	400.2	364.3	+ 6.1	35,486	32,896	+ 7.9
Michigan	42.9	46.9	45.1	— 4.9	4,103	4,106	— 0.1
Mississippi	108.3	109.2	120.3	— 10.0	9,996	10,675	— 6.4
Missouri	0.1	0.1	0.1	.....	12	14	— 14.3
Montana	24.2	24.7	24.5	— 1.2	2,203	2,188	+ 0.7
Nebraska	0.3	0.3	0.6	— 50.0	38	52	— 26.9
New Mexico	134.6	134.4	129.9	+ 3.6	12,000	11,578	+ 3.6
New York	13.9	14.1	13.2	+ 5.3	1,190	1,136	+ 4.8
Ohio	9.6	9.2	9.2	+ 4.3	811	764	+ 6.2
Oklahoma	398.6	420.5	406.5	— 1.9	37,612	36,331	+ 3.5
Pennsylvania	30.1	30.9	36.0	— 16.4	2,780	3,097	— 10.2
Tennessee	.....	.....	.....	.....	2	2	.....
Texas	2,155.5	2,339.7	2,430.6	— 11.3	204,680	217,780	— 6.0
Dist. 1—South Central	26.9	28.0	25.5	+ 5.5	2,454	2,327	+ 5.5
Dist. 2—Middle Gulf	142.2	158.2	170.5	— 16.6	13,947	15,486	— 9.9
Dist. 3—Upper Gulf	424.2	457.5	491.4	— 13.7	40,497	45,074	— 10.2
Dist. 4—Lower Gulf-SW	207.6	222.7	253.2	— 18.0	19,767	23,159	— 14.6
Dist. 5—East Central	42.2	45.0	43.5	— 3.0	4,009	4,000	+ 0.2
Dist. 6—Northeast	376.7	425.9	443.9	— 15.1	36,324	39,323	— 7.6
Dist. 7-B—North Central	60.9	65.5	43.2	+ 41.0	5,667	3,976	+ 42.5
Dist. 7-C—West Central	47.0	49.8	43.9	+ 7.1	4,356	3,972	+ 9.7
Dist. 8—West	614.3	658.8	667.4	— 8.0	58,507	60,360	— 3.1
Dist. 9—North	126.3	138.7	135.8	— 7.0	12,106	12,839	— 5.7
Dist. 10—Panhandle	87.3	89.7	83.4	+ 4.7	7,986	7,944	+ 0.5
Utah	0.2	0.2	.....	.....	9	.....	.....
Virginia	0.1	0.1	0.2	— 50.0	6	9	— 33.3
West Virginia	7.2	7.4	7.5	— 4.0	644	643	+ 0.2
Wyoming	136.7	133.8	142.6	— 4.1	12,108	12,799	— 5.4
Total United States	5,189.1	5,391.6	5,406.2	— 4.0	478,144	486,598	— 1.7







Looking Ahead

● POSSIBILITY of a general cut in crude prices hangs on, along with producers' hopes it will not occur. Gasoline prices have been holding, but lower prices of kerosine, distillate, and residual fuel oil leave less to be realized from processing a barrel of crude. Prices of heavy crudes have been cut twice in California and are lower in Caribbean area. Pennsylvania grade crude has been repeatedly reduced. However, crude production and stocks are not excessive, gasoline demand will be heavy, and greater use of heating oil is ahead.

● FURTHER INCREASE in oil consumption and volume of business is expected for 1949, but lower prices for some products threaten lower profits.

● RETURN OF prices of fuel oils to high levels of several months ago appears unlikely in view of improved supply situation.

● MID-APRIL FORECAST by Bruce K. Brown, president, Pan American Petroleum Corporation, estimates U. S. domestic demand for all petroleum products in aggregate in 1949 will be 6 percent over 1948. Expected increases include 4.5 percent for motor fuel, 9 percent for kerosine, 10 percent for distillate fuels including diesel, 5½ percent for residual fuel oil, 5 percent for all other products combined. Brown also foresees adequate refinery capacity and supplies of crude but no damaging surpluses.

● SPOT CHECK of purchasing agents in Mid-Continent area reveals that oil field tubular goods are still tight, with orders booked far ahead, but that material is much easier to obtain than a year ago. Gray market has disappeared. Steel in other forms is obtainable without much difficulty and will ease up further during next few months.

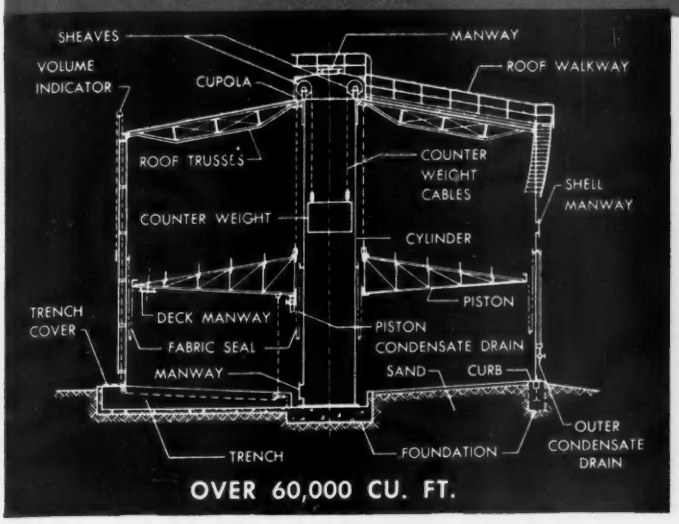
● OIL INDUSTRY of Alberta, Canada, eventually should rival that of Oklahoma, Kansas, or Texas, some geologists say. Also, there are good possibilities for oil and gas over other vast areas in adjacent regions of Canada, from U. S. border northward through Northwest Territories and Yukon to Arctic Ocean.

● CURRENT REFINERY construction will bring by end of 1950 quantity production of 80 octane "regular" and 85 octane "premium" gasoline. At present regular ranges up to 75 and premium up to 80.

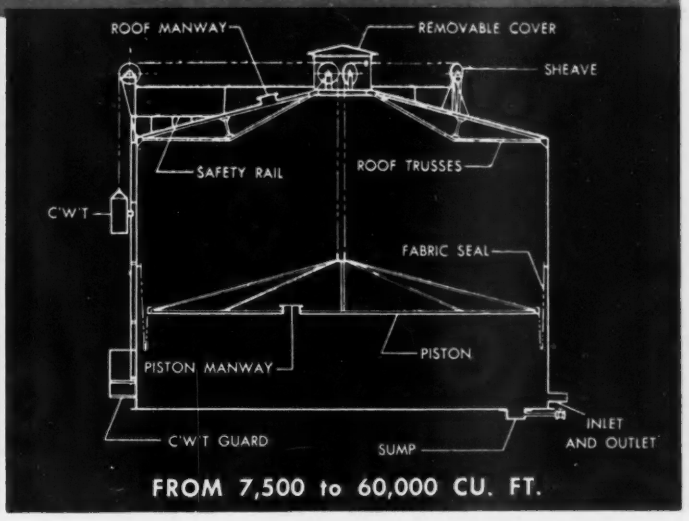
● PIPE LINE divorcement, proposed in Congress, would strangle free supply of oils, industry executives warn. Pipe line, barge, or tanker could not be owned or operated by any company producing, refining, or marketing. No refiner could market except at refinery gate.

● GAS UTILITY industry will make capital expenditures of $3.3 billion in five years 1948-1952, estimates American Gas Association. Capital requirements in 1948 were $875 million, a new peak, compared with $800 million in 1947. Present investment in gas utility industry is $6 billion. Of $3.3 billion to be invested in five years, 80 percent or $2.6 billion will be spent by natural gas companies, 15 percent or $500 million by manufactured gas companies, and remainder by mixed gas utilities. Natural gas pipe lines will require nearly half of $3.3 billion to be spent in five years.

WIGGINS *Dry Seal* GASHOLDERS



OVER 60,000 CU. FT.



FROM 7,500 to 60,000 CU. FT.

have proved a profitable investment,

because they offer . . .

1. A Gasholder with efficient operation and easy maintenance.

a. Not affected by snow load since all moving parts are under cover.
b. All major moving parts accessible for inspection during operation.
c. A vapor balancer that can be made gas free for repairs in a few hours.
d. A vapor seal that has a life equal to that of the tank.
e. A Gasholder working pressure of ⅛ to ¼ inch of water.

2. A vapor balancer that has a 100% Dry Seal.

a. Eliminates corrosion problems attendant with wet seals.
b. Requires no heating system during freezing weather.
c. Has no evaporation loss through a water or oil seal.
d. Requires no attention, adjustment or lubrication.

3. One vapor balancing mechanism for all tanks.

a. Provides flexibility of operation.
b. Permits repair of any tank in group without affecting operation.
c. Allows vapor balancer to be removed without disturbing storage tank operation.
d. Accomplishes all venting through one master valve.
e. One structure for protection of all standing and pumping loss.

WIGGINS CONSERVATION STRUCTURES

Hidek Floating Roof
Dry Seal Lifter Roof
Improved Breather Roof
Lodek Floating Roof
Dry Seal Gasholder
Improved Balloon Roof

For more complete details and Pay-Out Analysis, write for Bulletin VB-10

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Completions

7 Percent Above 1948 Period

WELLS completed during March totaled substantially more than the previous month's or those of March, 1948, to boost the total for the year's first quarter to a lead of more than 7 percent over last year's comparable period.

Completions numbered 3230 in March to top the 2533 drilled in February and the 2612 finaled in March of last year. In the first three months, this year has seen 8766 wells drilled against 8160 in the first quarter of 1948 for an increase of 7.4 percent.

An even greater increase was accomplished in the total footage drilled. This year's penetration has been 31,855,960 feet, while a year ago footage amounted to 28,157,601, a gain in 1949 of 13.1 percent. New wells on the average have been 181 feet deeper so far this year, having an average depth of 3669 feet against 3488 a year ago.

Chiefly responsible for this year's lead in drilling has been Texas, where wells completed in the first three months totaled 3136 against 2537 a year ago, an increase of 23.6 percent. The second ranking oil state, California, upped its drilling 7.9 percent by completing 668 wells this year compared with 619 a year ago. Kansas' activity climbed 13.7 percent to add 639 wells to the nation's total, while at the same time last year it had contributed 562.

Increased activity in the deep-drilling section of Louisiana raised the state's total wells for the three months to 459 against 408 last year. A loss of 14.7 percent in wells in the northern half of the state was more than offset by a gain of 56.1 percent in the southern region. South Louisiana with its comparative deeper drilling added materially to the year's increased well average depth.

Well Completions in the United States during March, 1949, and Cumulative for Year

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey; Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey; Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Allegany fields of Pennsylvania and New York from The Producers Monthly)

STATE or DISTRICT	MONTHLY COMPLETIONS, MARCH, 1949 — NEW WELLS: Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New	Total Drilled Deeper	TOTAL COMPLETIONS: Mar., 1949	Feb., 1949	Mar., 1948	Footage March, 1949	CUMULATIVE TOTAL: Wells 1949	Wells 1948	Percent Diff.	Footage 1949	Rigs in Operation (Drilling, Rigging Up and Shut Down): Mar., 31, 1949	Feb. 28, 1949	Mar. 31, 1948
Alabama				1				1		1			4,296	2	2		19,964	5	5	2
Arizona				2				2		2	1		4,324	3			7,766	6	6	7
Arkansas	12		1	7				20		20	24	13	85,088	60	65	— 7.7	276,529	25	30	41
California	202		2	42				246	2	248	213	197	1,021,960	668	619	+ 7.9	2,622,255	267	263	280
Colorado	2			3				5		5	1	18	28,553	9	67	— 86.6	43,235	26	28	63
Florida	1			4				5		5		1	41,642	7	6	+ 16.7	50,958	1	5	4
Georgia				1				1		1	1	2	3,710	2	2		3,710	1		
Illinois	79			63				142		142	151	104	369,828	442	428	+ 3.3	1,151,347	190	188	192
Indiana	40			51				91		91	51	72	186,843	219	215	+ 1.9	429,772	129	132	88
Kansas	139		10	96			2	247		247	193	165	832,574	639	562	+ 13.7	2,137,971	263	277	299
Kentucky	31		23	20				74		74	63	52	142,539	214	161	+ 32.9	384,828	75	83	67
Louisiana	91	14	11	48				164	1	165	126	152	988,708	459	408	+ 12.5	2,763,695	202	202	190
North Louisiana	44	7	9	13				73		73	56	101	248,425	214	251	— 14.7	719,787	60	55	54
South Louisiana	47	7	2	35				91	1	92	70	51	740,283	245	157	+ 56.1	2,043,908	142	147	136
Maryland															1	—100.0				
Michigan	28		2	43				73		73	72	37	159,350	219	149	+ 47.0	497,173	106	95	97
Mississippi	14	2		22				38		38	24	33	333,627	83	99	— 16.2	653,613	31	36	50
Missouri			1					1		1		6	433	2	12	— 83.3	949	6	9	7
Montana	16			2				18		18	8	25	43,053	44	74	— 40.5	126,083	46	53	46
Nebraska															1	—100.0		1		
Nevada																		1	1	1
New Mexico	27		6	9				42		42	43	41	186,474	125	147	— 15.0	571,311	95	105	107
New York	92			2	56			150		150	124	132	213,148	383	424	— 9.7	447,247	146	157	165
North Carolina																				
North Dakota																		1	1	
Ohio	23		21	36				80	1	81	78	109	193,528	263	271	— 3.0	629,228	152	161	199
Oklahoma	213	3	13	137	1		1	368	8	376	188	245	1,329,112	888	860	+ 3.3	3,368,508	484	489	556
Oregon																				
Pennsylvania	67		13	6	63	5		154	5	159	223	257	267,499	634	767	— 17.3	1,111,045	327	338	348
South Dakota																		2	2	1
Tennessee											3	5		6	10	— 40.0	6,058	7	10	20
Texas	717	21	39	402	2		1	1,182	20	1,202	886	857	5,172,669	3,136	2,537	+ 23.6	13,472,143	1,362	1,368	1,350
Dist. 1—South Central	23			37				60		60	40	41	182,699	149	121	+ 23.1	431,019	41	44	56
Dist. 2—Middle Gulf	25	1	6	19				51		51	46	53	314,284	136	175	— 22.3	835,108	65	59	73
Dist. 3—Upper Gulf	53	13	3	41				110		110	90	73	732,231	323	215	+ 50.2	1,997,791	146	144	119
Dist. 4—L. Gulf-S.W.	76	3	10	68				157	7	164	114	110	782,841	390	306	+ 27.5	1,933,018	115	130	110
Dist. 5—East Central	9	1		5				15		15	20	17	74,058	61	43	+ 41.9	301,019	29	26	30
Dist. 6—Northeast	86	3	9	12				110	1	111	49	36	505,894	239	98	+143.9	1,067,205	35	33	48
Dist. 7-B—North Central	89		8	87				184		184	82	97	551,680	408	292	+ 39.7	1,264,100	198	194	148
Dist. 7-C—West Central	23			8				31	2	33	5	32	174,362	61	91	+ 33.0	290,053	53	66	66
Dist. 8—West	187			21				208	8	216	192	220	1,096,328	584	635	— 8.0	2,971,160	408	401	475
Dist. 9—North	135			101	2		1	239	2	241	147	153	678,408	546	453	+ 20.5	1,539,965	135	134	105
Dist. 10—Panhandle	11		3	3				17		17	101	25	79,884	239	108	+121.3	841,705	137	137	120
Utah	3			3				6		6	2	2	30,558	9	6	+ 50.0	45,389	14	14	11
Virginia															1	—100.0				
Washington																				1
West Virginia	6		26	2				34	1	35	27	57	93,896	117	182	— 35.7	323,888	302	317	330
Wyoming	22		1	25				48		48	31	30	214,824	133	84	+ 58.3	624,295	96	116	104
Total United States	1,825	40	169	1,027	122	5	4	3,192	38	3,230	2,533	2,612	11,941,664	8,766	8,160	+ 7.4	31,855,960	4,369	4,491	4,626

Higher Crude Output To Be Needed

By L. J. LOGAN
Associate Editor

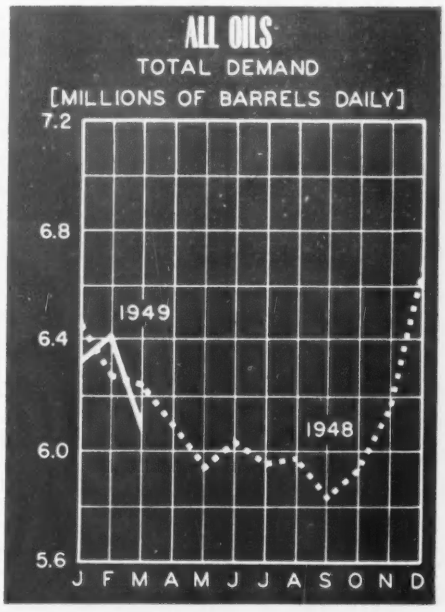
ALTHOUGH domestic crude production has been lowered by stages in recent months from more than 5,600,000 barrels daily in late 1948 to less than 5 million daily in April, 1949, it may have to be stepped up to near the late 1948 levels within a few months. This is indicated by current estimates of demand for petroleum products in the remainder of this year. To meet product requirements, U. S. crude production of around 5½ million barrels daily may soon be needed, if imports will be held to about the same levels as last year as promised by recent and prospective reductions of incoming shipments.

The sharp reduction in crude production in recent months was necessary in order to stop additions to stocks of crude and products which were occurring under the high 1948 rates of output. A mild winter held down consumption of fuel oils and accentuated the necessity of calling a halt to stock accumulations.

Reductions in crude production have held stocks to satisfactory levels, and following this recent readjustment or stabilization period, crude will be needed in larger volumes, the outlook for consumption indicates.

Although demand for petroleum was less than expected in the first quarter of 1949 because the weather held down fuel oil use, current estimates forecast that demand for all oils in 1949 will be 5 or 6 percent greater than in 1948. Domestic demand for motor fuel is expected to show an increase of about 5 percent. Other estimated increases are around 10 percent for distillate fuel oil and kerosine, 5 percent or less for residual fuel oil, and about 5 percent for other products combined. Even in the event of a business recession, total domestic demand should show an increase of at least 3 percent, one prominent petroleum economist has estimated. Working stocks will be adequate without showing any material net change for this year, it is indicated.

Trends of consumption, production, refinery operations, foreign trade, and stocks in the first quarter of 1949 are revealed in the accompanying table and charts. Daily average total demand for all oils was practically the same as in the first quarter of 1948, and crude production also was nearly the same, while refinery runs were nearly 2 percent higher. Motor fuel demand was up 8.1 percent, but there were decreases of 13.1 percent for kerosine, 1.9 percent for distillate fuel oil, 5.6 percent for residual fuel oil, and 8.7 percent for lubricants.



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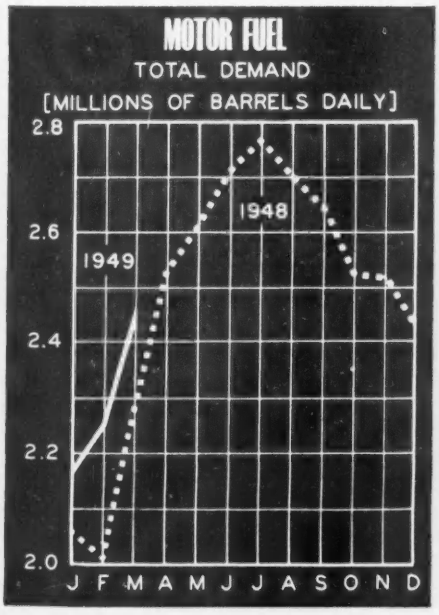

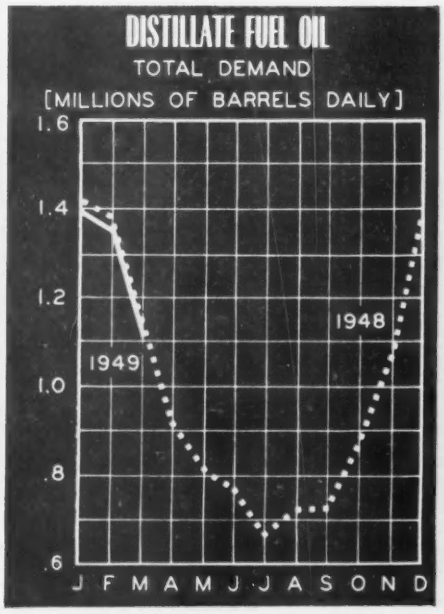

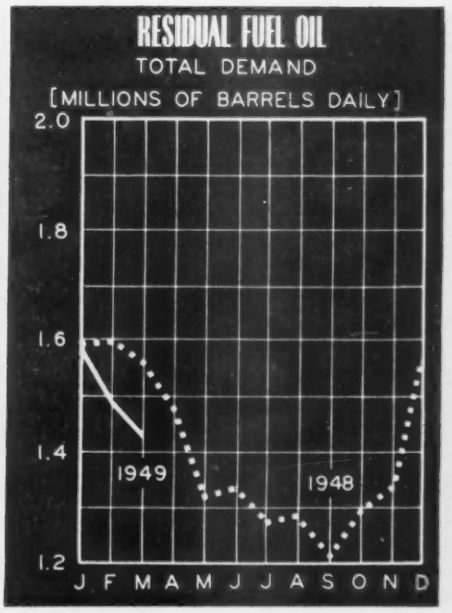

Demand for and Supply of All Oils, Crude Oil, Motor Fuel, Kerosine, Fuel Oil and Lubricants

Sources: U. S. Bureau of Mines except February and March, 1949, estimated with aid of A.P.I. reports

(THOUSANDS OF BARRELS)

ITEM	First 3 Months 1948	First 3 Months 1949	Percent Change
ALL OILS			
Domestic Production, Total	522,313	516,107	— 1.2
(Daily Average)	5,740	5,735	— 0.1
Crude Petroleum	486,598	478,144	— 1.7
(Daily Average)	5,347	5,313	— 0.6
Natural Gasoline	35,609	37,922	+ 6.5
(Daily Average)	392	422	+ 7.7
Benzol	106	41	— 61.3
(Daily Average)	1	.....	.....
Imports, Total	43,196	52,947	+ 22.6
(Daily Average)	475	588	+ 23.8
Crude Petroleum	25,463	36,847	+ 44.7
(Daily Average)	280	409	+ 46.1
Refined Products	17,733	16,100	— 9.2
(Daily Average)	195	179	— 8.2
Changes in Stocks, All Oils	—9,329	+3,159	.....
(Daily Average)	— 102	+ 35	.....
Stocks, Beginning of Period	500,800	605,189	+ 20.8
Crude Petroleum	230,654	256,254	+ 11.1
Refined Products	265,850	343,356	+ 29.2
Natural Gasoline	4,296	5,579	+ 29.9
Stocks, End of Period	491,471	608,348	+ 23.8
(Days' Supply)	78	97	+ 24.4
Crude Petroleum	234,164	267,395	+ 14.2
Refined Products	252,501	334,253	+ 32.4
Natural Gasoline	4,806	6,700	+ 39.4
Demand, Total	574,838	565,895	— 1.6
(Daily Average)	6,317	6,288	— 0.5
Exports, Total	28,087	30,600	+ 8.9
(Daily Average)	309	340	+ 10.0
Crude Petroleum, Total	8,756	7,000	— 20.1
(Daily Average)	96	78	— 18.8
Refined Products, Total	19,331	23,600	+ 22.1
(Daily Average)	213	262	+ 23.0
Domestic Demand, Total	546,751	535,295	— 2.1
(Daily Average)	6,008	5,948	— 1.0
CRUDE PETROLEUM			
Supply:			
Domestic Production, Total	486,598	478,144	— 1.7
(Daily Average)	5,347	5,313	— 0.6
Imports, Total	25,463	36,847	+ 44.7
(Daily Average)	280	409	+ 46.1
Change in Stocks (Including California Heavy)	+3,510	+11,141	.....
(Daily Average)	+ 39	+ 124	.....
Stocks, Beginning of Period	230,654	256,254	+ 11.1
Stocks, End of Period	234,164	267,395	+ 14.2
(Days' Supply)	42	48	+ 14.3
Supply, Total	508,551	503,850	— 0.9
(Daily Average)	5,588	5,598	+ 0.2
Demand:			
Runs to Still, Total	488,817	492,691	+ 0.8
(Daily Average)	5,372	5,474	+ 1.9
Domestic Crude	464,372	457,066	— 1.6
(Daily Average)	5,103	5,078	— 0.5
Foreign Crude	24,445	35,625	+ 45.7
(Daily Average)	269	396	+ 47.2
Exports, Total	8,756	7,000	— 20.1
(Daily Average)	96	78	— 18.8
Transfers to Fuel Oil Stocks	6,427	2,601	— 59.5
(Daily Average)	70	29	— 58.6
Distillate Fuel Oil	867	843	— 2.8
Residual Fuel Oil	5,560	1,758	— 68.4
Used as Fuel, and Losses	4,551	1,558	— 65.8
(Daily Average)	50	17	+ 66.0
Demand, Total	508,551	503,850	— 0.9
(Daily Average)	5,588	5,598	+ 0.2
KEROSINE			
Production, Total	32,989	28,661	— 13.1
(Daily Average)	363	319	— 12.1
Percent Yield from Crude	6.7	5.7	.....
Imports, Total	135	.....	—100.0
(Daily Average)	1	.....	—100.0
Change in Stocks	—7,258	—6,040	.....
(Daily Average)	— 80	— 67	.....
Stocks, Beginning of Period	17,722	23,895	+ 34.8
Stocks, End of Period	10,464	17,855	+ 70.6
(Days' Supply)	24	47	+ 95.8
Demand, Total	40,382	34,701	— 14.1
(Daily Average)	444	386	— 13.1
Exports, Total	692	700	+ 1.2
(Daily Average)	8	8	.....
Domestic Demand	39,690	34,001	— 14.3
(Daily Average)	436	378	— 13.3

ITEM	First 3 Months 1948	First 3 Months 1949	Percent Change
MOTOR FUEL			
Production, Total	213,355	230,921	+ 8.2
(Daily Average)	2,345	2,566	+ 9.4
Refinery Gasoline, Total	189,316	205,777	+ 8.7
(Daily Average)	2,080	2,286	+ 9.9
(Yield from Crude)	38.2	41.6	.....
Natural Gasoline, etc.	35,609	37,922	+ 6.5
(Daily Average)	391	421	+ 7.7
Less sales of L.P.G.	11,182	12,192	+ 9.0
Less transfers cycle prods.	494	627	+ 26.9
Benzol	106	41	— 61.3
Imports, Total	72	.....	—100.0
(Daily Average)	1	.....	—100.0
Change in Stocks	+20,797	+24,974	.....
(Daily Average)	+ 229	+ 278	.....
Stocks, Beginning of Period	87,407	101,001	+ 15.6
Finished Gasoline	83,111	95,422	+ 14.8
Natural Gasoline	4,296	5,579	+ 29.9
Stocks, End of Period	108,204	125,975	+ 16.4
(Days' Supply)	51	55	+ 7.8
Finished Gasoline	103,398	119,275	+ 15.4
Natural Gasoline	4,806	6,700	+ 39.4
Demand, Total	192,630	205,947	+ 6.9
(Daily Average)	2,117	2,288	+ 8.1
Exports, Total	6,664	10,000	+ 50.1
(Daily Average)	73	111	+ 52.1
Domestic Demand	185,966	195,947	+ 5.4
(Daily Average)	2,044	2,177	+ 6.5
DISTILLATE FUEL OIL			
Production, Total	98,775	91,981	— 6.9
(Daily Average)	1,085	1,022	— 5.8
Percent Yield from Crude	20.0	18.6	.....
Transfers from Crude	867	843	— 2.8
(Daily Average)	10	9	— 10.0
Imports, Total	1,014	350	— 65.5
(Daily Average)	11	4	— 63.6
Change in Stocks	—18,867	—22,777	.....
(Daily Average)	— 207	— 253	.....
Stocks, Beginning of Period	51,081	71,381	+ 39.7
Stocks, End of Period	32,214	48,604	+ 50.9
(Days' Supply)	25	38	+ 52.0
Demand, Total	119,523	115,951	— 3.0
(Daily Average)	1,313	1,288	— 1.9
Exports, Total	5,040	4,500	— 10.7
(Daily Average)	55	50	— 9.1
Domestic Demand	114,483	111,451	— 2.6
(Daily Average)	1,258	1,238	— 1.6
RESIDUAL FUEL OIL			
Production, Total	117,671	111,897	— 4.9
(Daily Average)	1,293	1,243	— 3.9
Percent Yield from Crude	23.8	22.6	.....
Transfers from Crude	5,560	1,758	— 68.4
(Daily Average)	61	20	— 67.2
Imports, Total	15,752	15,750	.....
(Daily Average)	173	175	+ 1.2
Change in Stocks	—5,146	—5,259	.....
(Daily Average)	— 57	— 58	.....
Stocks, Beginning of Period	47,091	63,993	+ 35.9
Stocks, End of Period	41,945	58,734	+ 40.0
(Days' Supply)	26	39	+ 50.0
Demand, Total	144,129	134,664	— 6.6
(Daily Average)	1,584	1,496	— 5.6
Exports, Total	1,903	3,500	+ 83.9
(Daily Average)	21	39	+ 85.7
Domestic Demand	142,226	131,164	— 7.8
(Daily Average)	1,563	1,457	— 6.8
LUBRICANTS			
Production, Total	12,823	11,845	— 7.6
(Daily Average)	141	132	— 6.4
Percent Yield from Crude	2.6	2.4	.....
Change in Stocks	+260	+557	.....
(Daily Average)	+ 3	+ 6	.....
Stocks, Beginning of Period	7,701	9,843	+ 27.8
Stocks, End of Period	7,961	10,400	+ 30.6
(Days' Supply)	58	83	+ 43.1
Demand, Total	12,563	11,288	— 10.1
(Daily Average)	138	126	— 8.7
Exports, Total	3,232	3,400	+ 5.2
(Daily Average)	35	38	+ 8.6
Domestic Demand	9,331	7,888	— 15.5
(Daily Average)	103	88	— 15.6

Industry Achieving Emergency Producing Ability

By L. F. McCOLLUM
President, Continental Oil Company

TOMORROW'S OIL industry, like that of the past and present, can be and will be both dynamic and stable. In a single year the industry has come from shortage to plenty.

This article is from an address of greater length given at the annual meeting of the North Texas Oil and Gas Association at Wichita Falls, March 26, 1949, entitled "Tomorrow's Oil Industry—Dynamic but Stable."

THE petroleum industry has demonstrated repeatedly and especially during the past year that it can and does serve the nation with exceptional achievement. It has shown that it is a dynamic industry—energetic, powerful, forceful, and progressive.

Because it is dynamic, it is also—and will continue to be—a stable industry, fixed, not easily moved, shaken or overthrown.

The force and energy of men in the industry give assurance that in the future, as in the past, the oil industry will be both dynamic and stable, serving the nation well.

The dynamic ability of the oil industry was proved beyond any doubt during the last 12 months, as record-breaking demands were met, scarcities overcome, and supplies made plentiful. In February, 1948, there was a 27-day supply of gas-oil and distillate. In February, 1949, there was a 41-day supply. In February, 1948, there was a 22-day supply of kerosine. A year later there was more than a 40-day supply. A 53-day supply of gasoline in 1948 was replaced by a 55-day supply in 1949. The record demonstrates that a dynamic industry, spurred by prices, offered a reward of a fair profit, can perform miracles.

A year ago we pleaded that the "problem" of short supply be left to free enterprise. We asked that the hand of government be withheld. We foretold that the full force of demand would result in adequate supply. Our plea was heeded, our performance was superb.

In the last two years, the domestic oil industry has expanded by one-fifth. Four million dollars has been invested in new oil wells, in new transportation facilities, in expanded refining capacity, in new and better marketing facilities.

Some say we have overshot our goal. In so far as the market and stocks of today are concerned, that may appear true. But for one, two, or five years ahead, I do not think it is true.

To arrive where we are today, the industry fought against the problems of manpower shortage, rising costs, public hysteria; battled delays in getting equipment, and delivery. We not only brought production and refinery runs to unprecedented levels in 1948 but also drilled more wells and footage than ever before, set a new record in number of wildcats drilled, increased known reserves of crude by the greatest amount in ten years. While pouring more and more oil into our refineries, producers added more than 2 billion barrels to our reserves, pushing them to an all time high of more than 26¾ billion barrels.

A Year's Achievement

A year ago people were questioning the ability of the oil industry. In one short year we have added to our reserves 2 billion barrels of oil and progressed to the point where we are "loaded with oil." In December, 1948, total daily production amounted to 6,120,000 barrels. Today we have allowable cut-backs of 800,000 barrels a day . . . and in addition to that another 100,000 barrels of production is shut in . . . in such states as California, Wyoming, Montana, Pennsylvania, and Mississippi, making a total of 900,000 barrels a day.

That, by itself, is 45 percent of the amount that the politicians and calamity howlers were saying we need as a "cushion" for possible emergencies. Such self-appointed experts have proposed taking about $9 billion from the pockets of the taxpayers. They propose to spend that, and more money, over something like ten years, to give our nation a 2 million-barrel-a-day "reserve capacity" from sources other than crude.

That's what they want: $9 billion as a starter and ten years to do the job. While they were asking that, the dynamic oil industry, in one year, and paying its fair share of taxes, instead of dipping into the public till, has been able to pile up, and shut in, daily capacity to produce that is equal to 45 percent of what the calamity howlers say they could do with the taxpayer's money in ten years.

The plan for a government-sponsored commercial synthetic program was the outgrowth of the petroleum scarcity of a year ago—but it is by no means a dead issue. As recently as March 8, a statement was issued by Interior Undersecretary Chapman, in which he said:

> "What we need are commercial-size plants with a substantial daily production of synthetic petroleum to help keep our industrial machine working at full capacity and to provide for oil in the event of war. It is estimated that in the event of another war, we would need at least 2 million barrels a day over and beyond present production."

I contend that—if we can do 45 percent of the job, we can do the rest of it. The dynamic nature of the American oil industry can serve America in some future emergency as it has in two world wars, and I know that it will. And, always, of course, there are the now-developing reserves of Canada upon which we can count, should there come the time when neither our own reserves, nor those of a state-subsidized synthetic industry, would be ample to cope with some emergency we are called upon to face.

Tomorrow's industry must continue to be dynamic. Despite our demon-

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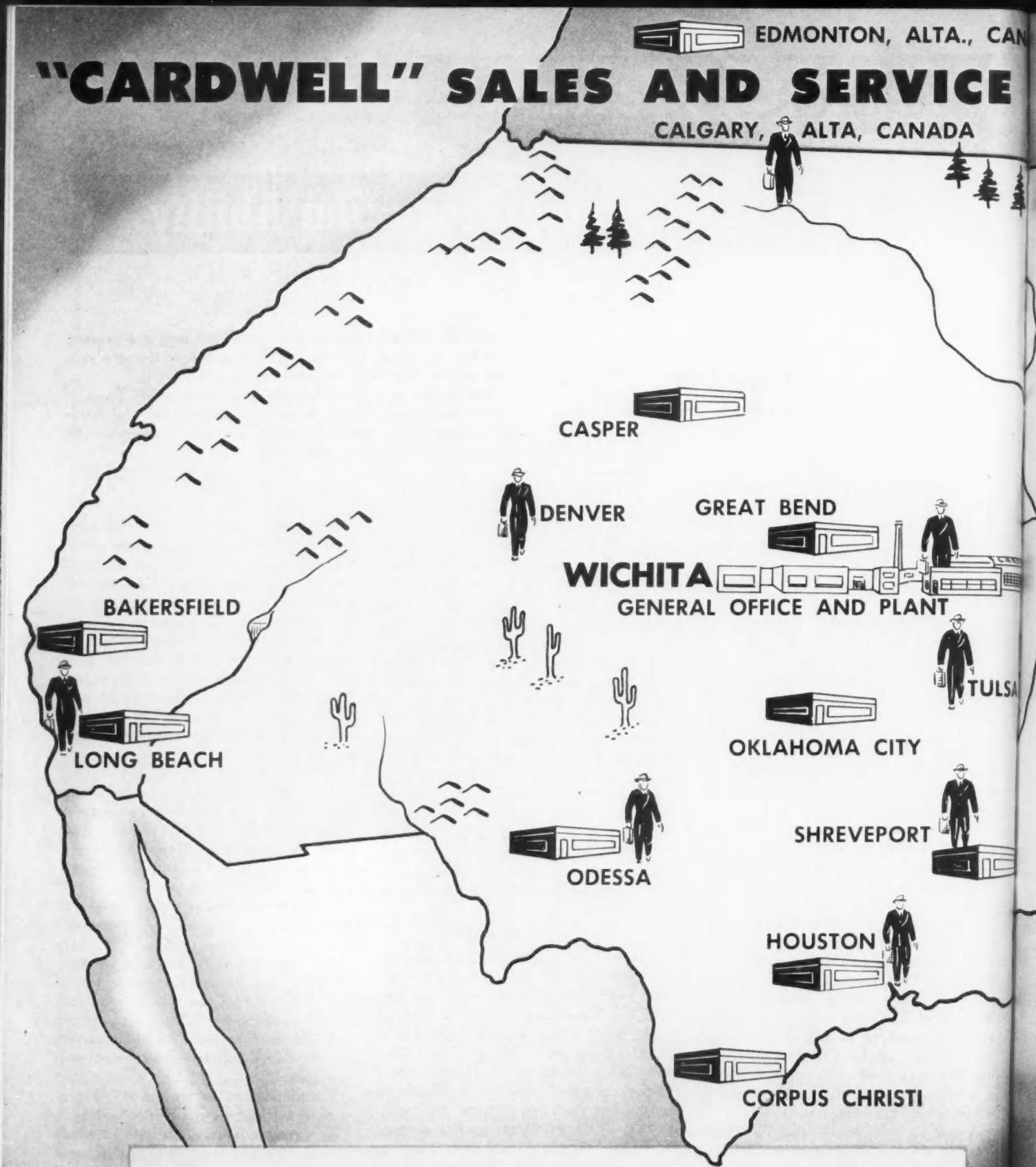

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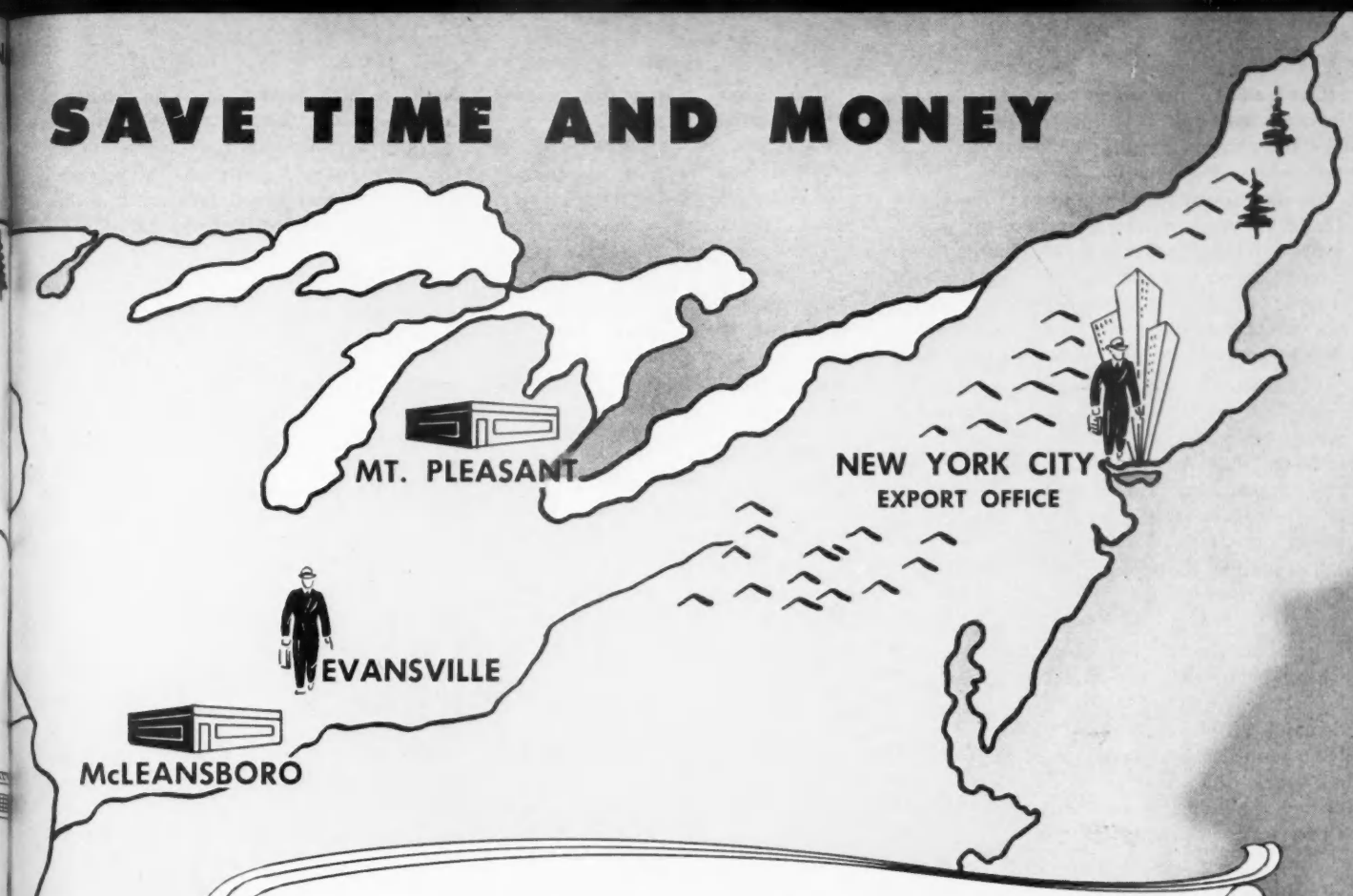

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strated ability, our competitive, capitalistic system still is subject to attack. We must forge ahead. We must build for ourselves a reasonable margin of capacity to produce, whether it be 1, 1½, 2, or more, million barrels a day in excess of today's demand. And I'm confident that we can and that we will. But, in order to continue dynamic, our industry must be stable. It must not be "easily moved, shaken or overthrown."

I was careful not to describe tomorrow's oil industry as "static," which means dormant and not active. The oil industry can be dynamic, stable, or even chaotic, but I doubt if ever it can be static. And I believe that it can be stable only because it is dynamic. The same abilities that we use to make ours a dynamic industry can be used to make it a stable industry.

Let's examine for a moment the forces which bear upon the stability of our industry. The first of these is increasing demand. More people using more petroleum products, making for us an expanding market, helps assure a stable oil industry. And there's no end, in sight, to an increasing demand for oil.

I could, and I know many of you can, cite the demand forecasts of economists and statisticians who have studied the possibilities. But, to illustrate my point, I would rather talk about some actualities instead of historical and potential percentages.

Each motor car on the road today consumes about 680 gallons of gasoline a year. And Detroit is turning out almost 5 million new automobiles a year. Yet, less than one-third of the cars on the road today are new ones. So, there will be new demands from motorists.

Each home oil burner consumes about 2000 gallons of fuel oil in a year. The oil burner industry estimates that, in new homes and old, an additional 500,000 oil burners will be installed in 1949. Now, that compares with the 160,000 installed in 1948.

More and more oil products are being used each year on America's 6 million farms. Mechanization is increasing agricultural production at an astounding rate. And farm mechanization is increasing the demand for petroleum.

Dieselization is another factor. Railroads aren't the only ones who are increasing their use of diesel power. Stationary diesels are being installed by all kinds of industry. And the growing plastics and chemical industries are getting more and more of their raw materials from petroleum. And liquefied petroleum gas is being used for just about everything, including plumbers' blow torches and cigaret lighters.

Such facts, to me, spell a steady demand. And a steady, expanding demand is one of the forces that will make ours a stable industry.

Another such force is conservation. Conservation has been an important factor in making ours a stable industry. We must see to it that conservation, properly practiced, continues to be such a force.

We all now know there is less profit in letting a well flow unchecked, letting it exhaust itself, in a matter of weeks and months, only to have to install prematurely expensive pumps. Or to have to drill a new well—at a highly increased cost per foot—when a little self-restraint, a little looking-beyond-today, would have resulted in the well flowing 50, 100, or 150 percent more than it did when it ran wild.

The regulated well with its steady, usually predictable flow of oil, is a stable well. Who knows how much the unchecked, free-flowing well may yield. To make sure that tomorrow's oil industry is stable, we must utilize the present conservation methods, we must search for even more information and still better methods.

Secondary Recovery

Secondary recovery is another means of increasing production, and conservation it is, when we realize that it increases the amount of a natural resource made available to consumers. Cooperative secondary recovery measures, legalized by statute if necessary, serve the public interest.

The precious material we produce, transport, refine and market is liquid energy. It is power in an extremely efficient and convenient form. We must exercise the utmost care when producing it. Both above and below the ground, in our oil fields, we must do everything we can economically to bring every barrel of oil to the surface, or to hold it safely and securely in storage.

Intelligent conservation laws must be observed, and new ones adopted, if found necessary. Excessive above-ground flaring of gas and other practices that prevent our getting the maximum recovery from every well that we discover must be stopped. I don't have to tell you that it costs a lot more to find oil today than it did ten years ago. So, when we find an oil well, we've got to get all of its oil we can into storage, into refineries and to the consumer.

Imports and Prices

Still another force, and within our own industry, that influences its stability, is the importing of oil. Imports of oil should continue, so long as they supplement and do not replace or displace domestic production. I stand foursquare behind the policy as outlined by the National Petroleum Council on imports. Imports can be and are a factor in making and keeping our industry a stable one. We must be realistic about imports, just as we are about conservation, and see to it that imports serve, not swamp us.

And finally, there is a fourth factor which will make our industry stable. And over this factor we have no control. This factor is price. In our free and capitalistic economy, the laws of supply and demand are immutable. One company can't change them. Nor can one industry, nor even a group of industries. Even our government, equipped with its war-time powers and operating rigid price controls enforceable by prison sentences, found it could not change the laws of supply and demand. Prices were set in the black markets.

Yes, we must have a stable oil industry tomorrow. These factors I have discussed will bring about stability. I don't think that one of them, alone, can keep our industry stable. More likely, two or more, exerting varying degrees of influence, will be the stabilizing forces. But, if we overproduce at the source, if we fail to practice proper conservation, if imports are permitted to flood us, then, gentlemen, we can look for stabilization to come form the economic forces of supply and demand.

Let us review how tomorrow's oil industry can be dynamic but stable. I am sure that it can be. We can find and have available in the ground the oil to assure us a reasonable reserve in the event of an emergency. In a single year we have come from shortage to plenty, and already have tucked away under our belts 45 percent of such an emergency "cushion." Let's go after the other 55 percent.

And while we're doing it, let's keep our industry stable. Let's develop new markets, supply new demands. Let's practice, develop and perfect our conservation methods and legislation. Let's implement the policy of the National Petroleum Council on imports, and use them to supplement the crude oil from American wells. And let's keep our industry stable by these methods rather than allowing economic forces to pound us into a chaotic, or inactive industry.

Our dynamic ability has been proved in an unfettered economy. A free interplay of supply and demand, prices and profits, enterprise and competition, has brought us to the pinnacle where we stand today. We want to continue to grow and develop under such conditions.

The experience, the skill, the knowledge, the efforts and the ability of men who are in the oil industry can make us sure that tomorrow's oil industry will be dynamic but stable.

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The Oil Industry's *Financial Relationships*

By JOHN D. GILL
The Atlantic Refining Company

FOR 15 years before 1947 the average price of crude petroleum and the composite price of petroleum products moved generally parallel to the composite price of other goods. In a less regular way oil industry profits and a large aggregate of industrial profits moved together; similarly, a composite of oil company common stock prices and a big group of industrial common stock prices. Of course, short-term deviations from parallelism occurred. The most notable recent deviations came in 1947 and 1948. During this biennium oil crude and product prices outran the average of other prices; oil share prices went ahead of the average of other share prices, by as much as 40 percent; and oil profits rose substantially more, relatively, than the rise to an all-time record of corporate profits in general.

For the two years, 1947-48, oil industry profits aggregated an estimated $4.1 billion. For the present purpose it is unnecessary to discuss the non-comparability of this volume of profits with volumes of previous years. But, it may be interesting to learn what made the large oil earnings possible. And it is important to know how they were used.

What happened is a good example of the working of competitive enterprise. The oil industry was competing with other industries for a preferential share of the people's purchasing power. Early in 1947, at then current prices, they demanded more oil than could be supplied, even though the units of the industry were using all of their resources to increase supply. So prices were bid up, not once, but several times over the year. The price increases did two things: they reduced the demand of those not willing to pay the higher prices; and they increased the industry's financial resources for the rapid expansion of supply. Events occurred as if the industry operated in an economy where capital could not be got by selling securities, but had to be obtained from consumers who were willing to pay at once for expansion of supply. In competition with other industries it was proved that the need for oil was so great as to warrant giving the oil industry a larger-than-average share of purchasing power.

So much for the events that brought the higher profits. How were the earnings used?

When the people spent more money for oil, they expected more. Did they receive more? The answer is emphatically "Yes." By the middle of 1948 the supply of a few minor products so exceeded demand at the then current prices as to cause price declines. By November the supply of one major product exceeded the declining demand for it by enough to cause a series of important price declines.

The change of the supply-demand relationship was effected by the industry's expenditure of about $5.8 billion for productive facilities during the time that its net profit was about $4.1 billion. Of the total spent, at least $2.4 billion represented that part of the public's purchase payments needed to mend wear and tear and replace depleted crude reserves. The remainder, about $3.4 billion, provided the effective expansion. Most of this came from the $4.1 billion of profits, after paying dividends.

The important feature of earnings in competitive industry is not their size, but their use. The size of the oil industry's 1947-48 earnings and the use to which at least the corporate portion was put, namely, productive facilities, suggest that this part of business should not be designated strictly private capitalism, but rather quasi-public capitalism. This is not a matter of mere words. Property title is, indeed, in the name of the stockholders; but the benefits of operation flow mainly to the public. A misunderstanding of the facts, and disregard of long-term trends in the development and operation of corporate industry has caused many avoidable labor-management difficulties.

PROFITS OF the petroleum industry in recent years have surpassed the earnings of other industries, as a result of intensified demand for oil products. The price increases which effected the higher profits were returned to the buying public in the form of expanded facilities and increased product supplies. The author discusses distribution of the industry's earnings and economic relationships of labor, management, stockholders, and the public. This paper was first presented before the National Federation of Financial Analysts Societies, New York City, March 8, 1949.

Judged in the light of at least two decades of experience, the oil industry's big earnings in 1947-48 were not big financial gains to stockholders. Out of earnings stockholders received cash dividends just about enough bigger than prewar dividends to cover the increase in the cost of living. The remainder of corporate earnings were plowed back to expand capacity to satisfy growing demand at successively lower prices until the industry is again in balance with other industries in competition for the public's patronage.

But, it will be argued, the corporate stockholder received not only cash dividends; he was credited also with the plowed-back earnings. That is a fact.

Over a period of time a stockholder's financial benefits consist of (1) cash dividends; and (2) appreciation in the market value of stock, if any, if realized.

Over a period of more than two decades, which included 1926 and 1944, the average cash dividends paid by a substantial group of oil companies was less than 3¼ percent of the market price in 1926, a not unusual year. The market price in 1944 was only about 10 percent greater than the market price in 1926. There is nothing extraordinary about these figures. The yield from cash dividends is quite representative of corporate industry, in general; and as for appreciation in market value: a very large aggregate of common shares of all sorts had a market value in 1944 slightly less than in 1926.

Whether appreciation in market value of the stockholder's equity is realized or not appears to depend primarily upon the sheer speculative aspect of the matter. It depends almost entirely upon the times when the stockholder buys and sells. The times may be doubly fortuitous, or doubly unfavorable, or one

erable period of years the average annual increment of market value for stocks in general has not exceeded about 0.8 percent.

I referred to labor-management difficulties growing out of misunderstandings of the cause and function of unusually large corporate earnings. Big earnings have incited employe representatives to ask for uneconomic wage increases or for bonuses, either of which, if granted, would compensate the recipients unreasonably more than comparable workers in other industries which did not, for sound economic reasons, experience above-average earnings. Moreover, adoption of such an unsound compensation policy would cause part of the high purchase price paid by the public for the primary purpose of expanding production to be diverted from this purpose, and thus delay the time when the public would have adequate supplies at industry-vs.-industry competitive prices. In paying higher prices to expand supply, the public is trying to help itself; not to pay workers a bonus for performing usual services.

I think that misunderstanding or ignorance of important economic facts is responsible for the charge that big business, meaning, I suppose, big corporations, has held wages down and prices up so that total employe compensation, as a share of the national income, has declined. I think it is true that salaries and wages, as a percentage of national income paid out, have declined in the last two or three years from the unusually high wartime levels. The drop is about 4.8 percentage points. No doubt some of this decline is due to ending overtime and other payroll inflations. But the chief cause, apparently overlooked, is the increase in the incomes of farmers and other self-employed persons. In this connection it is notable that between 1935-39 and 1947-48 the ratio of corporate dividends to corporate payrolls declined more than 40 percent.

The investigation of this matter has disclosed interesting and important relationships, which might well be kept in mind during all negotiations over wage rates and other compensation factors. For example, farmers as a group are earning as big a share of the national income as they did about 40 years ago, despite the fact that in relation to the whole labor force, there is now only one farmer for every two then.

Take another case. Other self-employers, as a group, are receiving as big a share of the national income as they did four decades ago, even though there are relatively only nine of them now for each 10 then.

Cash Dividends Down

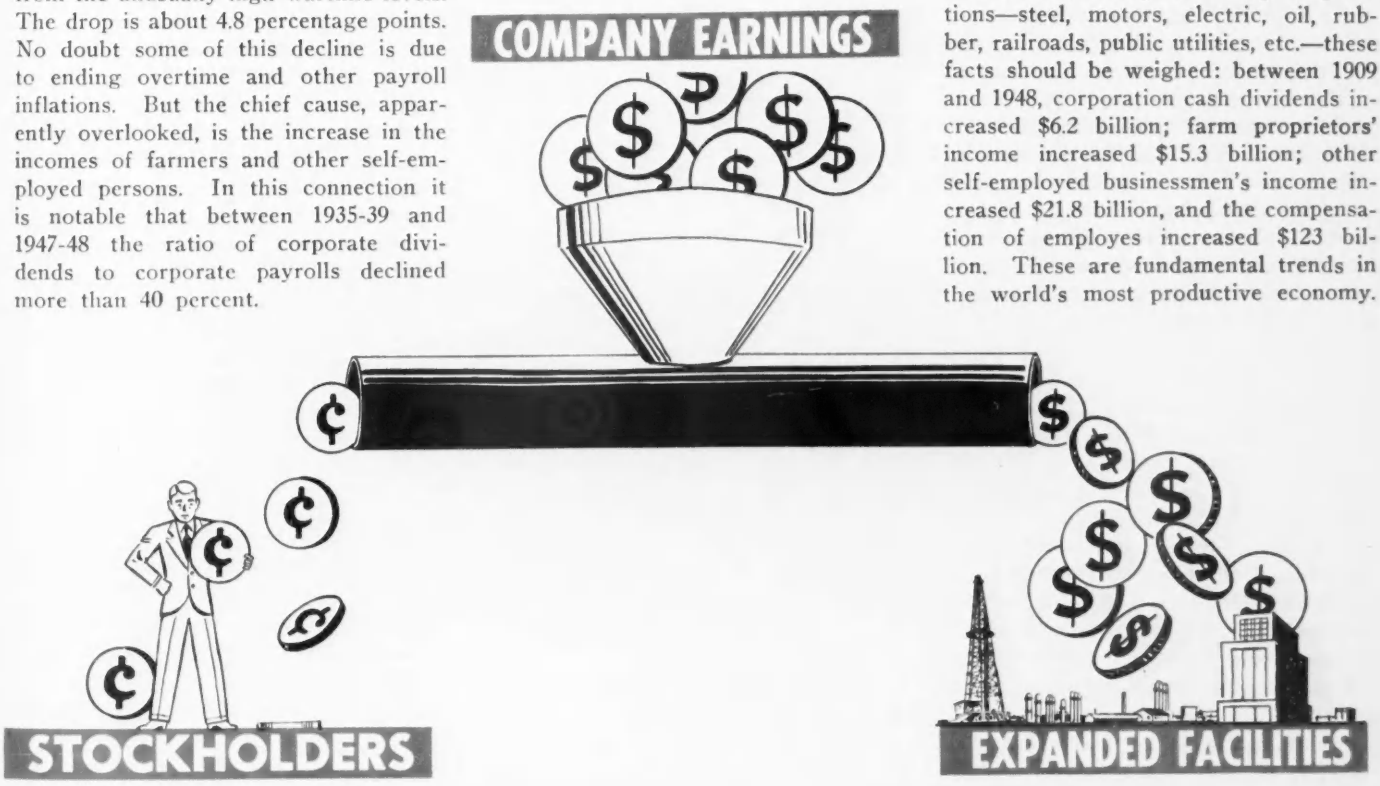
Contrast the foregoing two facts with this one: During the past three years corporation cash dividends, as a share of the national income, were only 60 percent as big as they were 40 years ago.

The 40-year period has been taken with due regard to the availability of data which provide the basis for significant long-term comparisons. By way of further illustration of these important relationships: the changes between the immediate prewar period of 1935-39 inclusive, and the last two inflation years, will be presented.

Between prewar and the two-year period, 1947-48, corporate dividends, as a percentage of national income paid out declined more than one-third. Over the same period total compensation of employes, as a share of the national income, increased slightly, while farm proprietors' income, as a share of national income, increased 22 percent, and other self-employed persons' income increased 36 percent.

This paper is essentially a plea for balanced economic thinking and action. In the absence of such conduct, leading corporations have been criticized for their high profits, and forced to lead the way to wage increases which have resulted in widening the gap between the wage leaders and the wage laggards. The result has been prolonged continuance of a disconcerting disequilibrium.

I plead also for better understanding of middle 20th Century economics to replace mid-19th Century economics. The entrepreneurs of the earlier period, with their allegedly selfish economic motivation and their high profits at that time, reflected by normal interest rates of 8-10 percent have been succeeded to a considerable extent by corporations, few of whose managements began as entrepreneurs, but began rather as specialists; for example: accountants, engineers, lawyers, etc., who were glad, indeed, upon leaving school to accept an opportunity to practice their specialty. These are the men who, succeeding to managerial power, operate corporations in the quasi-public-interest manner which I have briefly described. Of course, they hold their stockholders' interest uppermost, but 20th Century economics has established what must be done to protect such interests. The facts can be no more clearly or forcibly expressed than by the following figures. Remembering that most of our goods and services are provided by corporations—steel, motors, electric, oil, rubber, railroads, public utilities, etc.—these facts should be weighed: between 1909 and 1948, corporation cash dividends increased $6.2 billion; farm proprietors' income increased $15.3 billion; other self-employed businessmen's income increased $21.8 billion, and the compensation of employes increased $123 billion. These are fundamental trends in the world's most productive economy.



Industry Wants Research Free of Bureaucracy

Capable of measuring the amount of light from a candle five miles distant, this photo-electric recording Raman spectrograph analyzes petroleum products in the research section of the laboratories of the Standard Oil Development Company.

By HENRY OZANNE
Staff Writer

RECENT passage by the U. S. Senate of the bill for establishment of a National Science Foundation raises a crucial problem for American industry —particularly for the American petroleum industry which is now carrying about one-fourth of the nation's $450 million annual private research budget. It is expected that the National Science Foundation will be created by the present Congress, and on the character of the legislation enacted will depend materially the future of research by the oil industry in this country.

The Senate bill as sent to the House of Representatives provides for a Foundation of 24 members, all appointed by the President, for a term of six years each. The foundation would be authorized to develop and encourage a national policy for the promotion of basic research and to foster the exchange of scientific information.

Industry's chief objection to the legislation as now drawn is that it provides no check on the powers of the foundation's director, and confers on the foundation itself the right "to acquire by purchase, lease, loan or gift, and to hold and dispose of by sale, lease, loan, real and personal property of all kinds necessary for or resulting from scientific research." Industry leaders are urging that this provision be modified and limited to the acquisition of property necessary for carrying out the provisions of the act.

While the petroleum industry concedes the legitimate role of the government in insuring that adequate research be sustained in such fields as national defense, public health and safety, and conservation of natural resources, the industry also contends that as much research as possible should be left to private enterprise, both to save taxpayers' funds and to guarantee a free economy.

Research has become a major activity of the petroleum industry. The extensive research carried on by the industry has resulted in its meeting the increased demands for larger quantities and better quality of products, and for the development of scores of new chemicals. Standard Oil Company (N. J.) supports a $28 million research budget; the Royal Dutch Shell Group is maintaining a $24 million research program for 1949; and California Research Corporation has completed a $2 million expansion.

Other Projects

Union Oil Company has completed a new laboratory at its Wilmington refinery; The Texas Company has opened a synthetics fuel pilot plant at Montebello, Calif.; Humble Oil & Refining Company is constructing a new building at Baytown for its research personnel; Pan American Refining Corporation is building a process laboratory at Texas City; Gulf Oil Corporation has a new chemical and geological laboratory at Houston; the Carter Oil Company has doubled its laboratory facilities at Tulsa; Stanolind Oil and Gas Company will complete next year a laboratory at Tulsa for 600 scientists and supporting staff; Esso Standard has opened a new laboratory at Baton Rouge; Standard Oil Company of Indiana has opened one of the most modern and largest research laboratories in the world; Sinclair Oil Corporation has in operation its new research plant at Harvey, Ill.; The Pure Oil Company is building a research setup at Crystal Lake, Ill.; Cities Service Oil Company, will have a new laboratory at East Chicago, and Socony-Vacuum Oil Company, Sun Oil Company, The Atlantic Refining Company and other firms are building or have recently completed new research centers.

Furthermore, the oil industry has learned that research pays real dividends. The Standard Oil Development Company has found that over a period of ten years it has seen returned to it $15.41 for every dollar invested in research, accounted for as follows: Savings on royalties which would otherwise have been paid, $3.72; savings due to improvements in existing processes and products, $9.62; added profits due to new products, $2.07.

This, of course, constitutes the reason why the oil industry has given such long and consistent attention to research. Discovery and invention have been made possible in a contest of private enterprise, motivated by profit incentives. These, in turn, have redounded to the benefit of the American consumer. If the government takes an official hand in industrial research, the oil industry is insisting that such a hand be not a stultifying weight on further discovery and invention. As one petroleum industry leader said: "In research above all, bureaucracy will mean the slowing of scientific progress and the victimizing of the American consumer."

Should Stripper Wells Be Subsidized By Industry?

By EMBY KAYE
Consulting Engineer, Tulsa

OCCASIONALLY WORLD OIL, in the interest of stimulating thinking on a subject, devotes considerable space to a discussion of the "pros and cons" of a problem to which we can see no practical solution. This article falls into that category. The author deals at length with the arguments for and against a subsidy of stripper wells. In his concluding paragraphs he offers an approach to the solution, disclaiming a brief even for the idea he presents but opining that discussion possibly might bring out a practical working plan.

Frankly, WORLD OIL has the most serious doubts that a workable plan can be devised and put into effect, but believes that the author has provided stimulus to thinking on the subject.

MUCH has been said and written for a score of years about the necessity for some form of subsidy for "stripper" well production. A stripper well is defined as one whose production expenses approximate income. During this period, many operators of small wells have sought a better price for the oil from their wells on the plea that it was uneconomic for them to produce their wells on the same price basis on which producers of wells in flush fields operate; and certainly during periods when prevailing prices are as low as they were during the recent war years.

On the other hand, the purchasers have considered it economically unsound to pay a higher price for oil from small wells, contending that such oil is not worth more. Indeed, they contend it is worth much less because the purchaser is put to more expense in handling and accounting the small volume as against an equal volume from prolific fields. Crude values are determined by refining characteristics and distances from markets. Inevitable confusion would result from a pricing policy which discriminated on the basis of character or size of operations.

The pleas of many stripper well owners (incidentally, many such wells are owned by major oil companies) have been presented at oil association meetings and have been carried to the halls of Congress. During the latter part of the war, the plight of this class of producers was ultimately recognized and a subsidy was granted by RFC at the instance of OPA, which had resisted the most persuasive arguments for a general increase in the price of crude.

As of August 1, 1944, subsidy payments were made for production from pools averaging less than nine barrels per well per day on the following basis: less than nine barrels per day, 20 cents per barrel; less than seven barrels per day, 25 cents per barrel; less than five barrels per day, 35 cents per barrel, and a flat 75 cents per barrel in Pennsylvania, New York, Ohio and West Virginia for pools producing Pennsylvania grade crude. These payments were made to afford relief to producers of small wells who were hard pressed because of the freezing of crude prices at the low levels prevailing before we entered the war while labor and material costs had increased materially. The Oil Administration had recommended a 35-cent a barrel increase for all crude, but OPA disregarded the recommendation and initiated the subsidy after prolonged delays. This subsidy was discontinued on December 1, 1946, after crude was "decontrolled" by OPA and the price was increased by the purchasers.

Preventing Waste

It is doubtful that any group of oil producers would, as a peacetime practice, urge a subsidy for small oil wells on the basis of relief for a certain class of businessmen. The philosophy of a subsidy in a free economy must rest upon more solid ground. It must rest upon the broad principle of the national good. A subsidy for the production from stripper wells can possibly be supported on this basis. It possibly can be supported on the basis that such a subsidy would prevent or diminish the waste of an irreplaceable natural resource by preventing the premature abandonment of oil wells.

It is axiomatic that the amount of oil underground in the U. S. is not increasing at a measurable rate and that it was being decreased during 1948 at the rate of more than 5½ million barrels a day. Our total reserves, in excess of 23 billion barrels, excluding 3½ billion barrels of condensate and natural gasoline, and not taking into account future discoveries or substitutes, provide oil in sight for only 12 years, if all of it could be produced at the rate of consumption. Even though new discoveries and extensions of oil fields have somehow managed to offset the annual withdrawals, it is not certain how long we will be able to do this. But even if we should double the estimated oil reserves, we cannot look with solid comfort at the future available supply; not considering, of course, the more expensive substitutes.

Under these circumstances, it does not require much imagination to measure the importance of the more than 300,000 stripper wells which currently are producing about 675,000 barrels of oil a day, which is approximately 12 percent of the total oil production. Alone, this is a significant portion of the over-all production, but its importance is enhanced because this production is steady and does not decline as rapidly as the more flush production in newer fields. Too, more wells join the ranks of "strippers" every day. This is true notwithstanding recent price increases. These increases have served primarily to offset increased labor and material costs of the period following mid-1941. Statistics show, moreover, that about 10,000 wells are abandoned every year because they yield less than their operating cost. Salvagable material can be used to better advantage in developing new and perhaps profitable production. Recently many marginal wells were

being abandoned to recover pipe for new wells because of the critical shortage of tubular products available to the oil industry.

A well plugged is a reserve of oil irretrievably lost. The total recoverable reserves under wells abandoned were indicated to be 44 million barrels in 1942, 34 million barrels in 1944, and in excess of 18 million barrels in 1945, according to data developed by the Interstate Oil Compact Commission and released December 15, 1945, and December 9, 1946, respectively.

Decline in Abandonment

It is significant that the number of wells abandoned in 1942 was 10,541, or 438 more than were abandoned in 1945, during part of which year subsidy payments were made to the stripper wells, or rather to small wells. It is not an unreasonable assumption that the decline in abandonment was due in part to the federal compensatory payments which enabled the producers to maintain stripper wells in operation. Indeed, the additional income provided the necessary funds for conditioning the wells, an improvement reflected in part by the volume increase in production from stripper wells in 1944 and 1945, according to the same IOCC report, and by the slight increase in the production per well per day in these years. Many questionnaires sent out by the compact commission to the several states, when returned, contained the observation: "The compensatory payments (by RFC) played a part in keeping the very small wells producing beyond the normal time of abandonment."

Reference to the compact commission reports of 1945 and 1946 has been made to indicate the reserves lost each year by abandonments. However, the data referred to thus far dealt with oil recoverable by ordinary means, exclusive of secondary methods. Secondary arts are being studied on a greater scale than ever before and improved methods of evaluation and recovery are being advanced. The subject is receiving more than passing attention at technical sessions of oil associations.

The data from the several states collected by the compact commission showed estimates of additional oil which might be recovered from the stripper wells by secondary recovery methods with price increases of 25, 50 and 75 cents per barrel. The volume shown adds up to substantially 3 billion barrels. If these data are reasonably correct, and they are the best we have at present, this figure represents about 15 percent of our present reserves. To put it another way, secondary recovery methods applied to marginal fields might conceivably increase present known reserves by more than 15 percent.

Particularly important gains have been made in the practice of water flooding, no longer confined to reservoirs at relatively shallow depths. An outstanding example of flooding a deep reservoir is the Haynesville field, Louisiana, where the Petit formation is being flooded while the wells are still flowing. Successful floods have been developed in shallow fields which had long been strippers or where the wells had been plugged, but the producing horizons were not very deep, as, for example, in Pennsylvania and in the Independence area of Kansas. It is unlikely that where reservoirs are substantially below 1000 feet they will be re-drilled for water-flooding, once they are abandoned, unless the art is considerably improved. Re-development costs are and will continue to be too high to justify the assumption that re-development of such fields will be economic in the future. Such abandonments will represent permanent loss of reserves, as indeed, most abandonments are now.

If it be granted that premature abandonment of the wells in a field represents a wasteful loss of reserves, two questions are then naturally posed: Since additional compensation for oil from strippers will prevent the premature abandonments, how much of a premium or subsidy is required for effective results? By whom should such a premium or subsidy be paid? Although these questions have been buffeted around a good deal, there has been limited disagreement as to the first but no consensus at all as to the second.

The first question can, for the present purposes, be disposed of arbitrarily. It is quite obvious that any differential above the normal price of crude will defer the abandonment of a well or lease by some period of time.

If an operator during normal times employs the practice of abandoning a property as soon as it becomes uneconomic, assuming the property has in his opinion no possibilities in the direction of deeper drilling or secondary recovery, the payment of a subsidy of some amount would make that unit economic until a further decline in production, or until increases in lifting costs would wipe out the differential created by the subsidy. That might be a period of years or it might be months. This, of course, is elementary. It would seem that, if the principle of a subsidy is established and if that in turn carried with it the suggestion as to who should pay the cost, the implementation of such a program would not meet with insurmountable obstacles.

The writer approaches the problem in the following way: After the instrumentality for collecting and distributing the funds for subsidy purposes is developed, a fact-finding agency would set up the mechanics for determining from time to time, within certain limits, the price at which oil from stripper wells could operate profitably. That agency would determine the distribution of funds on some equitable basis which would doubtlessly take into account the average production per well in a pool, lifting cost and perhaps some other factors. In the end, it would come up with an answer like that of the recent OPA in providing compensatory payments to stripper wells. The mechanics of the plan will be discussed later. Suffice it to say that at present the plan envisages a substantial payment above market price to marginal wells.

Turning now to the second question, that is, by whom and how the subsidy should be paid, we are confronted with perhaps an irreconcilable difference or at least by a wide divergence of opinion. There are those who hold that the buyer should pay more for oil from stripper wells. Others believe that the Government should pay a subsidy, while a large group feels that the price of crude should always be such that strippers can be produced at the prevailing market price. It was pointed out at the outset that the first proposition, that the crude buyer pay more for oil from stripper wells, is economically insupportable and practically unfeasible. The last proposition, of course, belies the problem under discussion, and it shall not be further discussed.

Recent governmental and war psychology has developed quite a group of opinion which desires Government to do everything. Powerful interests in some industries which hitherto had frowned upon Government cooperation for fear of ultimate governmental control or interference with industry operations, now favor Government assistance of various sorts.

During the war, in addition to the stripper well group, the hard metals industry received compensatory payments on lead, zinc, copper, etc., where those products came from high-cost mines. With price ceilings maintained by the Government on these materials, a subsidy on production from marginal mines resulted in a greater production of critical materials without raising the price on those materials from all the mines of the country which accounted for the bulk of the production. This was a wise wartime measure with which no one quarreled. Nor was it considered generally objectionable that the Government compensated East Coast refiners for the difference between the cost of rail and tanker rates on oil moved by rail, on the theory that the undue costs generated by the war should be borne

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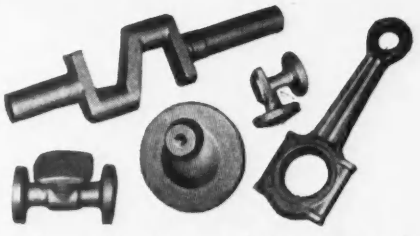

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by no special segment of the population and certainly not by the industry, which could not recoup the extra freight charges unless the Government increased the ceiling prices. The resumption of tanker movements abruptly ended the compensatory payments.

But with the war's end, the mining industry made the most determined efforts to continue the subsidy, although on a substantially lower basis, on metals from marginal properties. There is a grave question whether in a free economy inefficient production should be supported by the state. In this writer's view, it should not be supported by the state unless it is in the public interest to do so. In this case, it not only does not appear to be in the public interest to subsidize the production of metal ores from marginal mines, but definitely contrary to public interest. It would appear to be better to allow such mines to lie fallow, as it were, against the emergency when the ores might be needed, meanwhile producing the low-cost mines and importing to the extent necessary without endangering the economy of the producers of the low-cost mines. Generally speaking, the marginal mines will not deteriorate and the ores will remain for a harvest for future generations. Present owners will derive no income from them, but the national interest will not likely have been affected by their shutdown for the present. As stated, in the future in the event of an emergency these ores may well serve the national need.

A strong sentiment for postwar subsidies for stripper well production was developed by leaders of stripper well operator groups. The chief argument advanced was that the conservation of oil by preventing premature abandonment of wells was in the national interest and that subsidies paid for that conservation were therefore proper charges against the country at large. The costs should be paid for by general taxation, just as soil conservation, reforestation, flood control and irrigation. It might be countered that these are public projects while the subsidizing of private industry would be a different matter. Hence, the argument is brought forth that the treasury subsidizes farm products for the benefit of the farm industry. In this connection, it is argued, and with some propriety, perhaps, that a portion of the federal gasoline tax might be set aside to defray the cost of the subsidy. In this way, the consumers, the ultimate beneficiaries of conservation of oil, would directly pay the cost.

This might be an easy solution of the problem, but is it in harmony with our traditions? It would seem to be contrary to the very genius of our philosophy of government and economics and taxation. Furthermore, this writer believes that the industry has frowned upon the federal taxation of petroleum products except in the case of war. The use of even a portion of those taxes for this special purpose would freeze such taxes in the hands of the federal government. But there is, of course, a greater objection and it is reasonably clear to those who have watched government in action.

The suggestion of a government subsidy to the oil business is passing strange, to say the least, coming from oil men. It is difficult to believe that men who yesterday feared assistance in the matter of conservation because it might somehow lead to government meddling or control, and hence wanted none of it, are now willing to take a subsidy from that government, with all the implications of such aid.

Those who paid the subsidy, it would seem to be at least reasonably likely, would want to know what it was paying for. It would very probably set up machinery for defining stripper wells and to administer the government's function in this respect, and in perhaps other matters related to it. They would sooner or later, but certainly, have something to say about the operations of the industry they were subsidizing. Indeed, if the government paid the cost, it doubtlessly should have something to say about the operations to which the subsidy is granted. It would be called upon to pay no mean sum if the subsidy were to be effective, for it could reach an amount approaching several hundred million dollars a year.

It might be extreme to say that the agency the government would set up to administer a subsidy would want to control operations and perhaps the drilling of certain wells. Improvident operation would hasten the call on the government to apply the subsidy. Similarly, improper location of new wells might make them an early burden on the government, hence their location should be controlled by the government. Before writing off such possibilities as ridiculous, the reader should study the accretions of power in the hands of the FPC with respect to the natural gas industry. Much of the extreme power exercised by the commission to which the industry has taken exception stems from interpretations of the law by the commission or by the courts and not by specific grants by the Congress. Bureaucracy has the faculty of extending itself and once entrenched with authority it is difficult to pry loose.

The whole idea of a federal subsidy is repugnant to the philosophy of private enterprise and is at odds with the character of the rugged individualism which made this industry great. Besides all the other objections on principle, it carries far too great a risk for the industry to assume.

Industry Support Plan

Several years ago, the writer advanced the suggestion for a plan to provide substantial payments to producers of submarginal wells, but the cost of which would be borne by the industry and through it by the consuming public, the mechanics handled through industry instrumentalities. The plan may be simply stated. For every barrel of oil produced in the U. S. a sum (between 5 and 10 cents) would be collected by an appropriate industry agency into a common fund, the proceeds of which would be allocated to stripper well production on an equitable basis. This is, of course, an over-simplification.

There were several valid objections to the plan: it required (a minimum of) government cooperation; it was difficult to administer; a certain state with large production would oppose it on the theory that it, or rather its producers, would

TABLE 1

Grade or Percent of Total Wells	Wells in Group	Average Production Per Well	Total Daily Production	Subsidy Per Bbl.	Dollar Subsidy to Group
Penna Grade	122,000	½ bbl.	61,000	$0.90	$ 54,900
50 percent of balance	89,000	2½	123,000	.65	89,945
35 Percent of balance	53,000	5	265,000	.45	119,250
15 Percent of balance	26,000	8	208,000	.30	62,400
Total Wells	299,000	.....	657,000	....	$325,000
Total Daily Production	.....	.....	657,000	....	.....
Total Daily Subsidy	.....	.....	.....	....	$325,540
Total Collections at 7 cents	.....	.....	.....	....	$392,000

TABLE 2

Penna Grade	61,000	$1.20	$ 73,000
50 Percent of balance	123,000	.90	110,000
35 percent of balance	265,000	.60	159,000
15 percent of balance	208,000	.35	72,800
Total Daily Production	657,000	....	.....
Total Daily Subsidy	.....	....	$414,800
Total Collection at 9 cents	.....	....	$504,000

Data on distribution of production by groups or well sizes extrapolated . . . with some best guessing . . . from OPA releases. They showed 50 percent in the top bracket (probably excluding Penn. grade) and 15 percent in the lowest subsidy bracket.

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pay a disproportionate part of the cost. And perhaps there were other objections.

Nothing has occurred in the intervening time to recognize the special status of stripper well production and its specific needs except that it has, as a part of the industry, benefited from the several general increases in the price of crude since the end of the war. But costs, too, have gone up. The average price of crude is now well over twice that prevailing for a ten-year period prior to the end of the war, but it is conceivable that it might come down. (Prices of Pennsylvania grade crude oil have been lowered about one third in a series of six reductions in the past four months, with purchasing companies explaining that supply was exceeding demand.) But certainly, the goal of the stripper well operators to obtain "a permanent differential in price for oil at the well," the study of which was initiated by several trade associations during the war, has not been achieved, and as far as this writer knows nothing of a positive nature has been advanced except governmental subsidy. Because the need for special treatment of this type of production is manifest, these views are being presented.

Let us pass by the problems, and there are many incident to such a program, and consider briefly its merits:

1. The crude buyer would not be penalized by having to pay more for oil of equal quality whether it came from stripper or from flush production.

2. The increased cost, if any, would be borne by the consumer, who alone should pay therefor, as the ultimate beneficiary of conservation.

3. The inflow of funds would be large enough to provide a real incentive to the prolongation of stripper production and a positive deterrent to the premature abandonment of small producers.

On the basis of a 10-cent-a-barrel charge against every barrel of production in the country, the "take" would on late 1948 basis be $560,000 per day. Applied against an assumed 657,000 barrels of stripper production, that would mean an available 85 cents per barrel for subsidy. Obviously, the premium would be paid upon some graduated scale so that the barrel produced from the smallest well would receive the optimum and that from the larger well, a smaller bonus. The smallest producers could well receive in excess of a dollar per barrel.

There is no magic in the 10-cent figure nor in any suggested distribution of the common fund. The important thing is to pay enough premium to make for maximum production from the affected wells by encouraging expenditures for most efficient maintenance of the operation and for secondary recovery wherever feasible, thus deferring abandonments. Nevertheless, several suggested schedules are shown in the accompanying tables, based upon probable distribution of production among the pools and wells.

In Table 1 a collection of 7 cents per barrel is assumed and 9 cents is assumed in Table 2.

The mechanics of collection and distribution present no major problem. The agency set up to make the distribution would look to the first purchaser of crude to collect the amount due (by deductions, of course), for the account of the agency. The method used for distribution would be substantially that used in the OPA subsidy operation. The first purchaser paid the producer and was reimbursed by the DSC. OPA designated the pools and the amount of the subsidy to be paid. DSC then wrote relatively simple orders respecting the filing of monthly statements showing separate listings for purchases from each of the several pools. Naturally, in the present situation, the least expensive and the least cumbersome handling would be developed and instituted. What the government did, industry can do, and doubtlessly better and cheaper.

Legal Problem

There is, of course, a legal problem. The collection of a per barrel contribution for every barrel of oil produced in the U. S. is doubtlessly a form of taxation, even if all of those funds are returned to the industry. It might have the earmarks of a semi-private processing tax. Some will look at it as something on the order of John Lewis' provident fund although the latter was established as a result of "voluntary agreement" between Lewis' union and the coal operators.

It would seem to be manifestly proper to petition the Congress to authorize the collection of an amount up to 10 cents a barrel for every barrel of oil produced in the several states through the instrumentality of an agency set up under the supervision of the Interstate Oil Compact Commission. The proceeds, less administration expense, would be distributed to producers on the basis of a yardstick developed by that agency from time to time, for the stated objectives. The agency would have the power to change the basis of the fund distribution as conditions warranted. It would, of course, decide what factors to take into account in determining what pools would be considered stripper pools and the per barrel allowance which would be made for each pool.

The writer believes that it would be within the purview of the Oil Policy (final report PAW April 16-17, 1946, Government Printing Office) suggested by the Petroleum Council in 1946 to look to the government for such cooperation. Several numbered paragraphs thereof are pertinent:

2. "The problems of conservation and waste of oil are primarily industry problems; regulation for achieving conservation and preventing waste are matters of exclusive state jurisdiction."

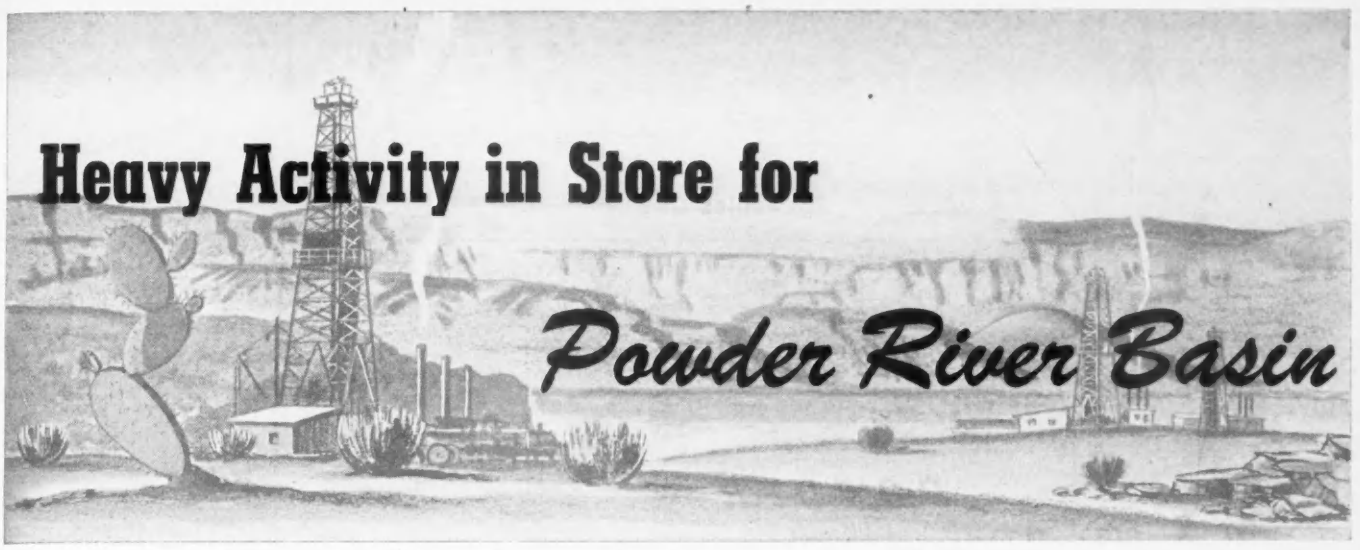
14. "While the federal government should not enter into the field of regulating production . . . it can assist the industry and the states by appropriate cooperative legislation.

A. "The Interstate Oil Compact Commission, the advisory and coordinating agency to the state conservation bodies, should be recognized as the effective medium for disseminating knowledge and advancement in the regulation and conservation of oil and gas."

The writer holds no brief for this approach. His main thesis is that if the objectives of a premium for stripper production are meritorious, that is to say, of advantage to producer and so manifestly in the national interest, certainly such a program should not flounder and fail either because the authority for such procedure is lacking or because it may meet with objections from some producers in several states who may feel that they are making a disproportionate contribution to any such program. Nor should it be rejected because the method suggested for implementing such a program is too fuzzy. If the ends sought are as meritorious as they appear, there are men in the industry who could devise a plan with less objections thereto.

The most fortuitous time to effectuate a program as herein comtemplated would be during a period when the crude market is strong, preferably when a price increase is imminent or likely. Theoretically, if not practically, part of the increase might be designated for the "assessment." But whether or not this self-imposed contribution is tied to an increase in the price of crude, or whether it comes as a tax specifically authorized by the Congress, now is the time to introduce some form of self-sustaining subsidy or premium device. When and if prices decline, some "stripper well" reserves will be lost. With price reduction will come, as always, an increase in abandonments.

This plan may have no merit. The writer's objective is, however, to bring about discussion out of which might ultimately come some solution of an industry problem almost as old as the industry itself. Tied in as it is with the national welfare, it would seem to merit consideration of some of the industry's "best minds."



Heavy Activity in Store for Powder River Basin

By BEN FUNK

POWDER RIVER BASIN of Wyoming and Montana is an especially favored region for exploratory drilling in 1949, following active leasing, exploration and drilling in 1947 and 1948.

This year will bring continuation of special interest in areas in deeper portions of the basin, following discoveries in 1948 in locations away from the rim and blocking of large acreages in the central sections.

Active drilling in the Mush Creek area in the east of the basin is due to continue, and there will be exploration also in the north and west portions of the basin.

Indications for 1949 point to heavy exploratory drilling around Mush Creek and on a general basis in the north and northwest. Some deeper drilling, probably below 10,000 feet, is in store for the southwestern section of the basin.

IN THIS year's field development, the Powder River Basin of Wyoming and Montana continues to be one of the most interesting areas of the Rocky Mountain region.

Developments in 1947 and 1948 set off intensive leasing, exploration and drilling activities.

Last year brought discoveries away from the rim of the basin and the blocking of large acreages in the central sections indicate the continuation of that trend for this year. The heavy testing by drilling in the Mush Creek area in the east of the basin is expected to go on. Major operators will probe the basin in the north and on the west.

Huge Area

There is plenty of land to cover, (see map, next page). The basin is mainly in the northeastern quarter of Wyoming, but extends into southeastern Montana. The area of leasing, exploration and drilling covers about 26,000 square miles, roughly between latitudes 43 and 46 and longitudes 104 and 107. Generally defined, the basin is bounded on the west by the Big Horn mountains and on the east by the Black Hills and stretches well into Montana along the Powder River. The area extends northward from the North Platte River in Wyoming.

The Wyoming section of interest is approximately 150 miles from north to south and 135 miles from east to west. The Montana play covers more than 110 miles from east to west and probably around 60, more or less, from north to south. Wyoming counties partly or entirely included are Sheridan, Johnson, Natrona, Converse, Niobrara, Campbell, Weston and Crook. Powder River, Carter and Big Horn counties are included in Montana.

Oil has long been produced along the rims of the basin. Millions of barrels have come from Salt Creek, on the southwest of the basin, and Lance Creek, in the southeast.

Salt Creek, in Natrona County, 39n-79w, 40n-79w, led Wyoming's oil boom after World War I. It was the state's greatest producer until Lance Creek, 35n-65w, 36n-65w, Niobrara County, revived the lagging oil picture and became the No. 1 Wyoming production section in the 1930's.

The old Billy Creek gas field is on the western edge of the basin. The 30-year-old Osage oil field is on the east, not far north of booming Mush Creek.

The Salt Creek light oil field dates back to the first decade of the century. It reached a peak production of 30 million barrels in 1924 and was still good for about 4 million barrels in 1948. Lance Creek production dates from 1918. The production of oil with a gravity in the low 40 range hit a top of more than 9 million barrels in 1940. It had dropped to around the 3 million mark last year.

Postwar Boom Begins

The postwar Powder River Basin boom was touched off in 1947 by Mush Creek developments. The area (44n-63w), Weston County, northeastern Wyoming, was discovered just after World War I. But there was no production until a few thousand barrels were brought up late in World War II. Production two years ago climbed above 100,000 barrels. To demonstrate the success of feverish wildcatting resulting from 1947 activities, production was ten times as great—more than 1 million barrels—in 1948.

Mush Creek remained the area of greatest Powder activity in 1948. How-

POWDER RIVER BASIN, MONTANA AND WYOMING

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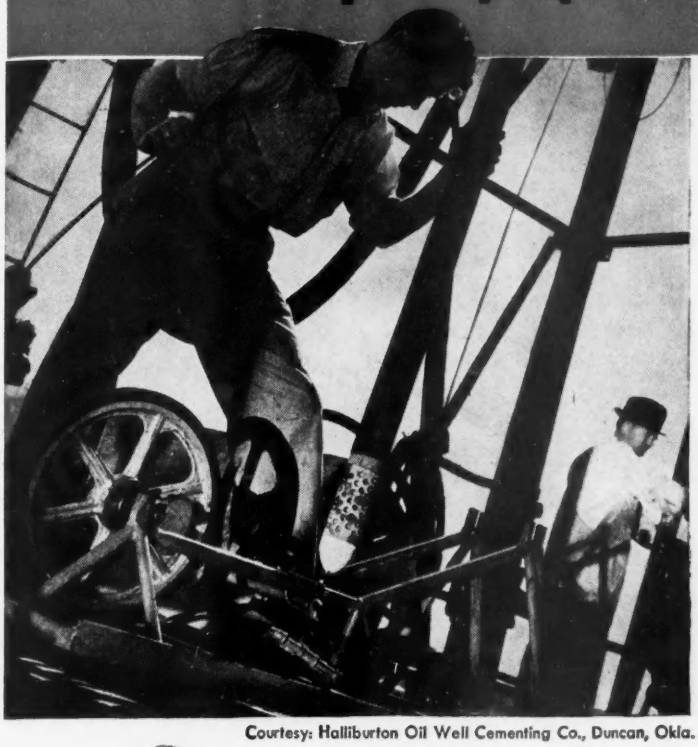
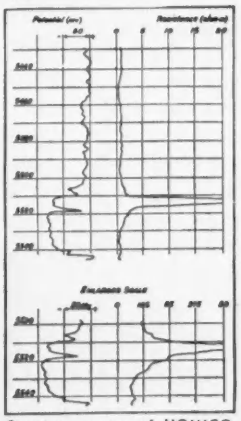


Courtesy: Halliburton Oil Well Cementing Co., Duncan, Okla.

HOWCO engineer about to start Logging Electrode down the hole.



Specimen curves of HOWCO electric well logging, indicating shale down to 5510', oil sands at 5510' to 5518', and below that salt-water sands.

what you've got . . . and where . . . in well drilling is less and less a guessing game as science moves further into the oil country. Example: The HOWCO Logging Electrode (Halliburton Oil Well Cementing Company, Duncan, Oklahoma), which spots "pay" formations and tells you exactly where they are, top and bottom!

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ever, there were significant developments in the basin to the northwest and across it near the southwestern edge.

One of the most important developments of 1948 was The Texas Company's discovery at Adon, C NW NE 2-52n-72w, in the north-central part of the basin. The location is in Wyoming's Campbell County, where there had been exploration activities for some years.

Texas' hit moved interest from previous concentration on rim production and resulted in leasing and exploration activities along the center section.

Oil was discovered at Adon in 1947 but the official completion of the No. 1 unit was not until 1948. Production from the Minnelusa, topped at 8997 feet, was rated at 244 barrels a day. The hole was 9007 feet deep.

Two other Texas wells at Adon, one to the west and the third to the north, were dry holes and abandoned.

The significance of the discovery was not lessened, regardless, and the pull of interest away from the rim and leasing and seismographic work were slowed little, if any. Nor did the drilling of dry holes even farther north of Adon dampen interest much. In fact, leasing pushed on across the state line and into Montana.

Another first-rate Powder Basin development of 1948 and early 1949 was Continental Oil Company's discovery at Sussex in Johnson County 20 miles north of the long productive Salt Creek field. Continental hit on two of three wells. The initial flow from Alice Coles No. 1 was 241 barrels a day of light green oil. Saturation was encountered in the Lakota at 7710 feet. The total depth is 7710 feet.

The discovery also helped dent the long concentration on the basin rims and led to lease blocking along the west and in the southwest.

Continental's Alice Coles No. 2 went to the Sundance at 8073 feet but formations encountered were dry and hard and the well was abandoned after going to 8424 feet.

Third Test

The third well in the same section was completed early this year to 7729 feet, and in a 24-hour test flowed 300 barrels of oil through a quarter-inch choke. The potential was rated at 1000 barrels a day and Continental readied for more drilling.

Operators began to move west from Mush Creek last year and a big development of that eastern basin area was Bay Petroleum Corporation's discovery 15 miles to the west in C NW SE 9-44n-66w. There saturation was encountered in the Dakota at 6720 feet. The hole was bottomed at 6737 feet. Water troubles developed and when remedies failed operations were suspended.

But the extension was held sufficiently promising to touch off leasing play and wildcatting in the area.

Mush Creek holes, productive and otherwise, have been drilled to half-way through the 3000-foot level down to nearly 6000 feet. Oil of an average 35-degree gravity has come from the Newcastle sand.

The deposit is believed to be jagged horizontally and a good deal of testing was done by drilling. This accounts for the fact that there were 49 dry holes last year. But 90 producers also were brought in.

There were less significant basin developments last year in the south and southeast and even to the northwest. These with the eastern activity around Mush Creek and the northern and southwestern developments at Adon and Sussex marked 1948 as primarily a year of exploration and indicated what to expect in 1949.

Encouraging Producers

At Fiddler Creek, between Mush Creek and the Osage field, the Clark Drilling Company brought in a Newcastle producer for 238 barrels daily in NW NE SW 19-46n-64w. There was considerable drilling at Skull Creek, east of the Mush development, and some encouraging completions as well as a number of dry holes, as expected. Brinkerhoff Drilling Company was a heavy operator and had a successful Newcastle completion in NW SW SE 3-44n-62w. Test drilling extended north of the Mush-Skull-Fiddler-Osage region clear into Montana. There were some shows but the program remains to be carried to the conclusive stage. Southeast of the basin there was activity as intense as elsewhere east and north to the established Lance Creek production. Continental had a discovery at Little Buck Creek. Little Buck Creek is east of the Lance and East Lance fields. Southern basin developments included an eastern extension of the old Big Muddy field.

Indications for 1949 point to heavy exploratory drilling on the offset pattern in the east around Mush Creek, at comparatively wide intervals radiating from Sussex in the southwest, and on a general basis in the north and northwest. Some deeper drilling, probably below 10,000 feet, is in store for the southwestern section of the basin.

Winter conditions—and they were the worst in Wyoming for many years—halted or slowed operations and preparations for the 1949 campaign. All activities are somewhat hampered by road conditions. The Powder basin is primarily a ranching-grazing area and lack of population has made a heavy road network unnecessary. There are country roads to some extent. The terrain, while valley-cut, is for the most part rolling, and not too difficult to traverse.

The belief in the possibilities, at least of the Mush Creek area, is shown by the several applications to the Wyoming Public Service Commission for pipe line outlets.

The last half of 1947 and 1948 developed a virtual stampede for land leases in the basin. Federal and state land offices were overrun. Big operators were active. The boom brought outfits not ordinarily operating in Wyoming.

One of the outstanding developments, particularly in late 1947 and the early months of 1948, was the interest of small investors. They concentrated on the eastern section, particularly Mush Creek. One development was the interest and investment by professional and business circles in Cheyenne, Wyoming's capital. Most went into general leasing-drilling-development companies. Others invested in small leasing combines. Independent operators also concentrated on developments in the eastern part of the basin. Major companies also were included in the rim play.

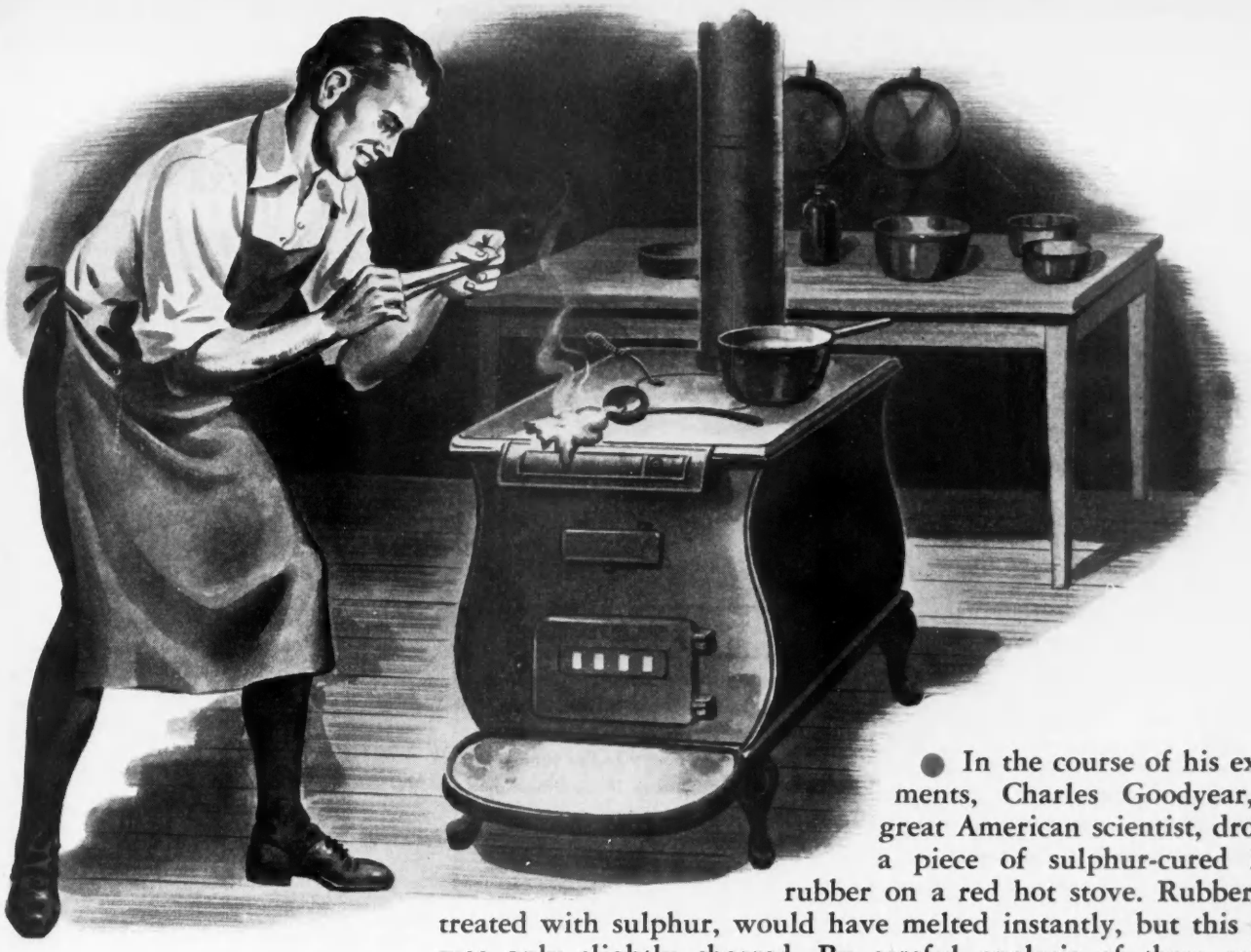
The outstanding 1948 trend in leasing was the interest in the north-central and southwestern and south-central regions. The play was mainly by larger operators. Especially did this trend follow Texas' discovery at Adon. Acreages were blocked in Campbell, Sheridan and Johnson counties in Wyoming and the play extended into the basin in southern Montana. The future status of the northern leasing play hinges on planned drilling for 1949.

Continental Active

Millions of acres in the southern, western and south-central basin sections were taken up after the Continental discovery at Sussex. Continental alone has blocked about 350,000 acres. Others in the play include Amerada Petroleum Corporation, which plans a deep test north of Sussex.

A third important 1948 leasing development in the basin followed Bay Petroleum Corporation's Lodgepole discovery to the west of Mush Creek. This moved the previous eastern rim trend westward into the basin. Independents and majors, including Continental and The Carter Oil Company, were involved in the trend extension.

Montana lease play as the result of northern and central basin developments in Wyoming involved mainly Shell Oil Company. Also interested were Amerada and Gulf Oil Corporation. Phillips Petroleum Company also was in the play picture. Blocks were assembled in Big Horn, Powder River and Carter counties.



● In the course of his experiments, Charles Goodyear, the great American scientist, dropped a piece of sulphur-cured India rubber on a red hot stove. Rubber, untreated with sulphur, would have melted instantly, but this piece was only slightly charred. By careful analysis of these results, Mr. Goodyear discovered vulcanization.

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Correlation of Seismic Events With Geological Horizons

By NEAL CLAYTON
Geophysicist, Republic Exploration Company, Tulsa

A SEISMIC event may be defined as a burst of energy recorded at the surface which may be described by the mathematical laws governing elastic wave motion and which occurs as a result of either reflection or refraction at some geological interface. In the past it has been assumed that differences in density and especially elasticity were primarily responsible for a return of energy to the surface. The author believes that differences in sedimentation or lithology may often have more to do with the recording of a reflected or refracted event than do sudden or abrupt changes in density or elasticity, although these factors are interrelated.

IT HAS BEEN commonly assumed that in recording a seismic event or burst of energy, differences in density and elasticity were primarily responsible for a return of energy to the surface. However, differences in sedimentation or lithology often may have more to do with the recording of a reflected or refracted event than do sudden or abrupt changes in density or elasticity, although these factors are inter-related.

The recorded time for each event represents a composite picture or the time integration of all layers through which the "pulse" has passed, both descending and ascending. Thus, in order to determine the spacing or time separation of reflected events one must know the interval velocities of the layers through which the energy has passed. In the absence of any reliable velocity information the best method is to prepare "time" maps since this should give a true relative picture of the area. The relative positions of any major unconformities in the geological section must be kept in mind as these might affect the degree of accuracy of such maps when turned over to a geologist.

In the past several methods, with varying degrees of accuracy, have been used for determining the velocity distribution in a given area, e. g.; t^2 vs. x^2 curves from reversed profiles, correlations at a well, and shooting in a well. The latter method is by far the most accurate. The author is of the opinion that too little attention has been paid in the past to making well surveys in such a manner as to be of greatest value to the geophysicist. For example, the usual practice has been to take shots at random, say every 500 feet, in order to release the logging truck as soon as possible. A study of the geological section might reveal that more effective shots could have been taken at the top and base of all limestone, sand, or shale sections, and at all unconformities.

Once the average velocity to a known reflecting horizon is known, experience has shown that as a rule this velocity increases as some function of the amount of overburden. An exception to this rule is found in Noble County, Oklahoma, where the velocity to the Viola limestone decreases from north to south. The accuracy of any seismic survey is most certainly related to the kind of velocity information at hand, as well as the manner in which such data are utilized.

There are several reasons why it is to be expected that seismic events should not correlate exactly with geological horizons. In the first place the actual paths may be quite different in the two cases. A straight line reflection path is usually assumed for the sake of sim-

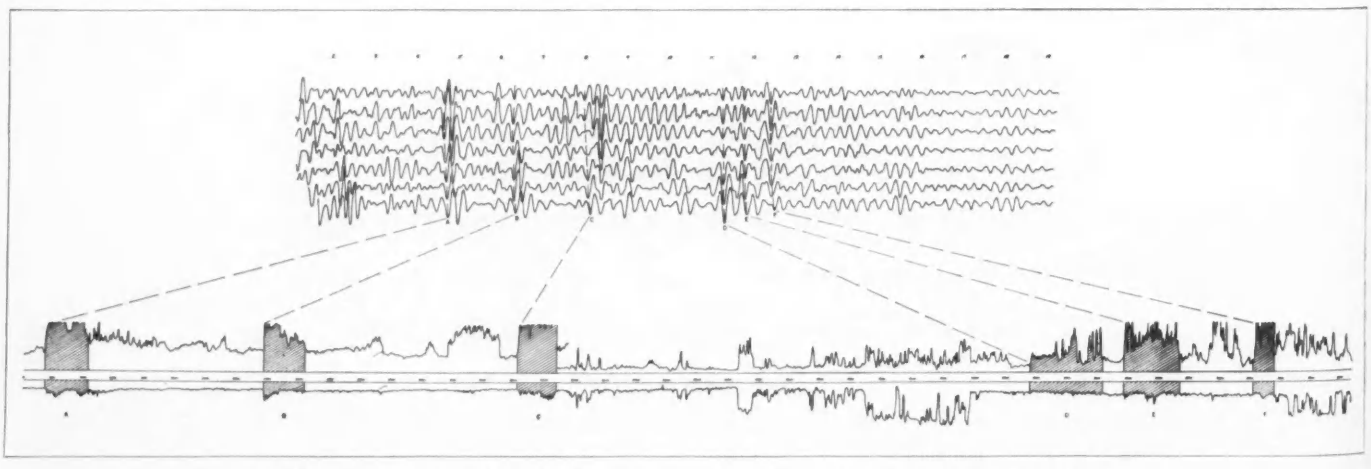


FIGURE 1. Correlation of a seismic recording and an electric log in Hopkins County, Texas.

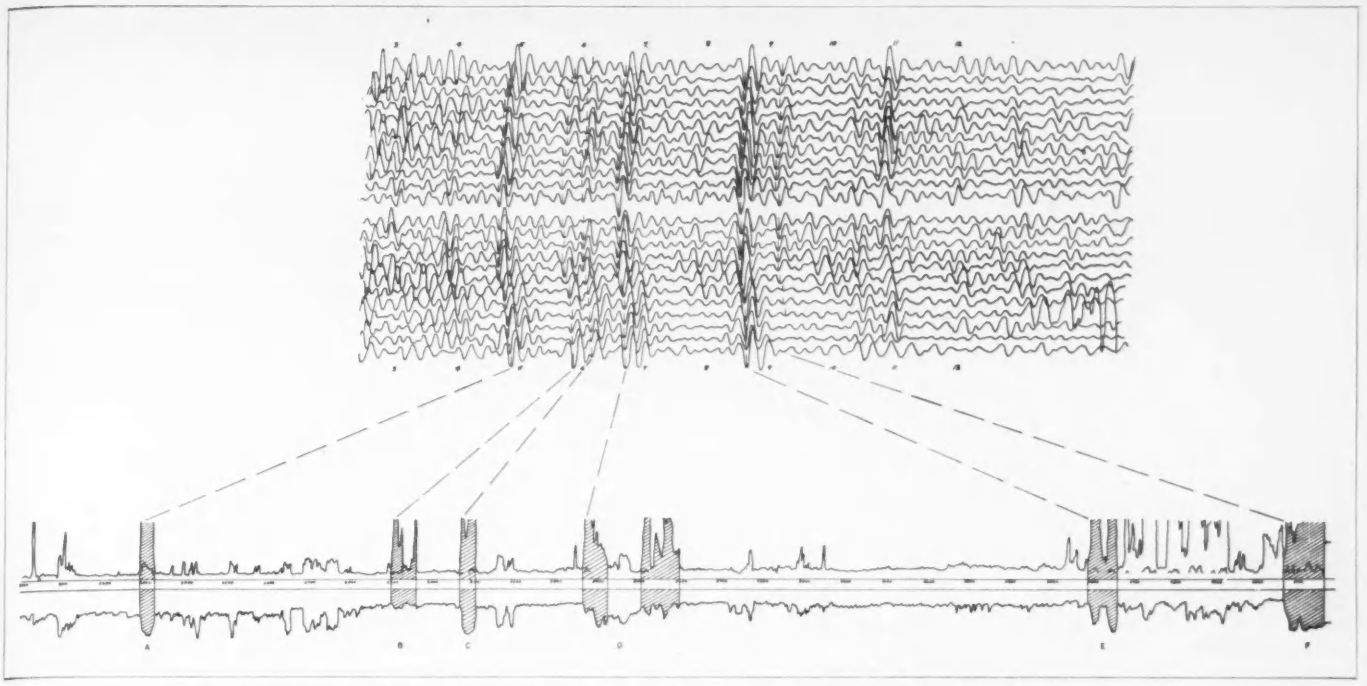


FIGURE 2. Correlation of a seismic recording and an electric log in Throckmorton County, Texas.

plicity but the actual path is most likely quite complicated. Dr. C. H. Dix has shown that even velocities obtained from well surveys may be in error due to variations in the path from shot to detector. Assuming that well velocities are correct still leaves many variables on the seismic record. Phase changes due to instrument response, shot depth, surface formations under the geophones, etc., may prevent exact correlation and be unrelated at the same time to the lithology of the sub-surface.

On the other hand changes in thickness or lithology of a reflecting horizon may so alter the shape of the "pulse" as to make correlation difficult. An example of this is the Hunton limestone in Oklahoma when less than 100 feet thick. The principal difficulty to further research along this line seems to be that no one knows the exact nature of a "pulse" when it leaves a shot hole. For this reason little can be done toward predicting what changes will occur before the "pulse" returns to the surface and is recorded.

Refracted events, on the other hand, lend themselves more readily to correlation with well surveys. The application of Snell's Law with known interval velocities and the ultimate refraction velocity usually suffices to determine the refractor, at least to the degree of accuracy expected of such a survey.

Certain criteria may be used as guides in attempting to correlate a seismic record with a well log. Notable among these are the following: the general absence of persistent events in thick shale sections; unconformities in the section; the use of isopachs; the fact that most limestones are good reflectors while sands usually give weak events. Often a series of alternating sands and shales may give a composite "pulse" which changes character over an area. As a rule the average velocity to a geological horizon on a seismic record is lower than that revealed by a well survey.

Seismic interpretation has come a long way from the days when a velocity was "adjusted" in order to make it fit an outstanding event which might conceivably be the horizon desired. Correlations of this type resulted in erroneous interpretations, e. g., the mapping of the Mississippi limestone in place of the Viola in some parts of central Oklahoma.

In certain areas, however, positive correlations may be made with known geological markers. An example of this type of area would be Hopkins and Hunt counties in East Texas where positive correlations from the Pecan Gap to the Goodland limestone are possible. Figure 1 represents such a correlation between a seismic recording and an electric log of a nearby well. Table 1 gives the corresponding average velocities obtained from the seismic record.

Certain areas in North Central Texas

Table 1

Reflection A—Pecan Gap	6771'/S
Reflection B—Gober Chalk	7249'/S
Reflection C—Austin Chalk	7780'/S
Reflection D—Georgetown LS	8450'/S
Reflection E—Fort Worth LS	8616'/S
Reflection F—Goodland LS	8855'/S

Table 2

Reflection A—Saddle Creek LS	9750'/S
Reflection B—Palo Pinto LS	9900'/S
Reflection C—Upper Strawn LS	10,185'/S
Reflection D—KMA LS	10,198'/S
Reflection E—Caddo LS	10,744'/S
Reflection F—Miss. LS	11,094'/S

Table 3

Reflection A—Senora LS	9070'/S
Reflection B—Booch Sd.	9642'/S
Reflection C—Gilcrease Sd.	9682'/S
Reflection D—Union Valley LS	9793'/S
Reflection E—False Mayes LS	9832'/S
Reflection F—Hunton LS	10,065'/S
Reflection G—Viola LS	10,330'/S

About the Author

NEAL CLAYTON was born at Ripley, Miss., and received his B.A. degree from Mississippi State College and his M.S. in physics from Louisiana State University. His first geophysical job was in 1937 with Humble Oil & Refining Company. In 1932 he became affiliated with Seismic Explorations, Inc., Houston, and later with the Naval Ordnance Laboratory at Washington, D. C. In 1943 he joined Magnolia Petroleum Company. Three years later he joined Republic Exploration Company at Tulsa.

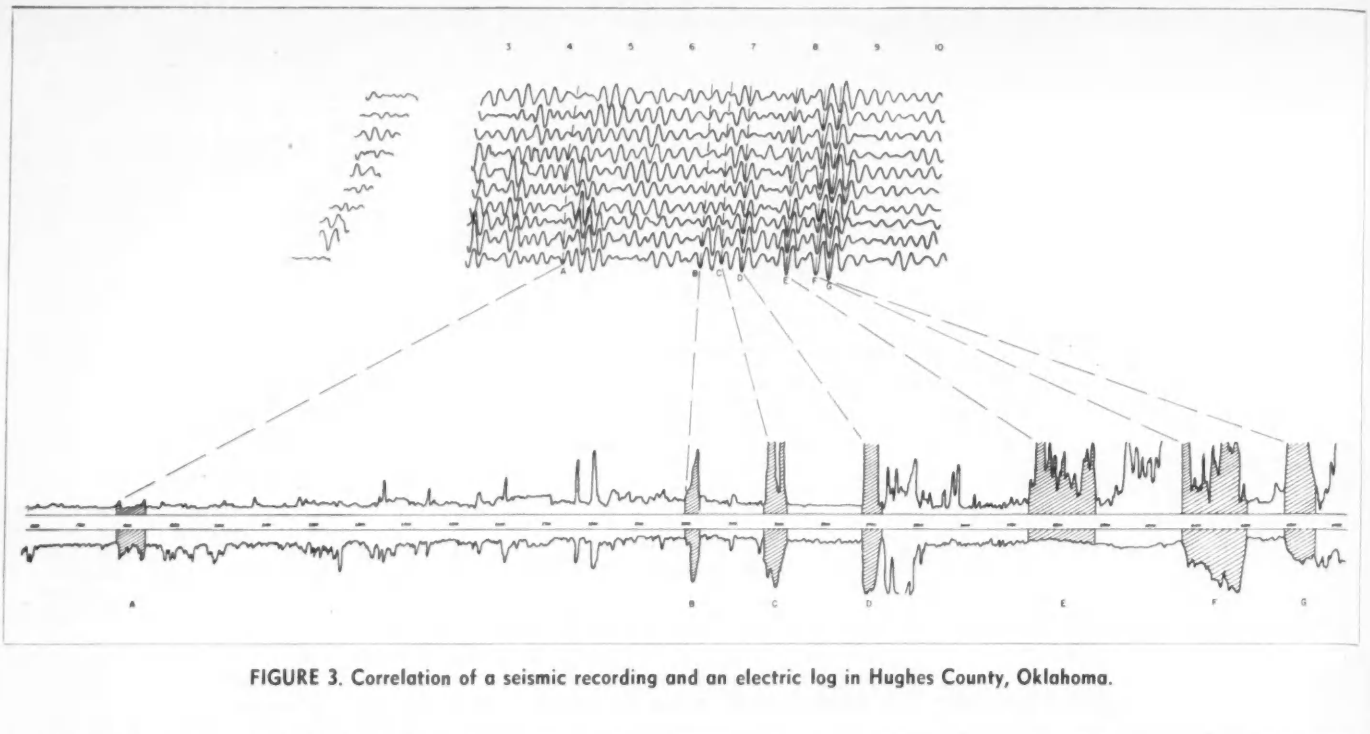


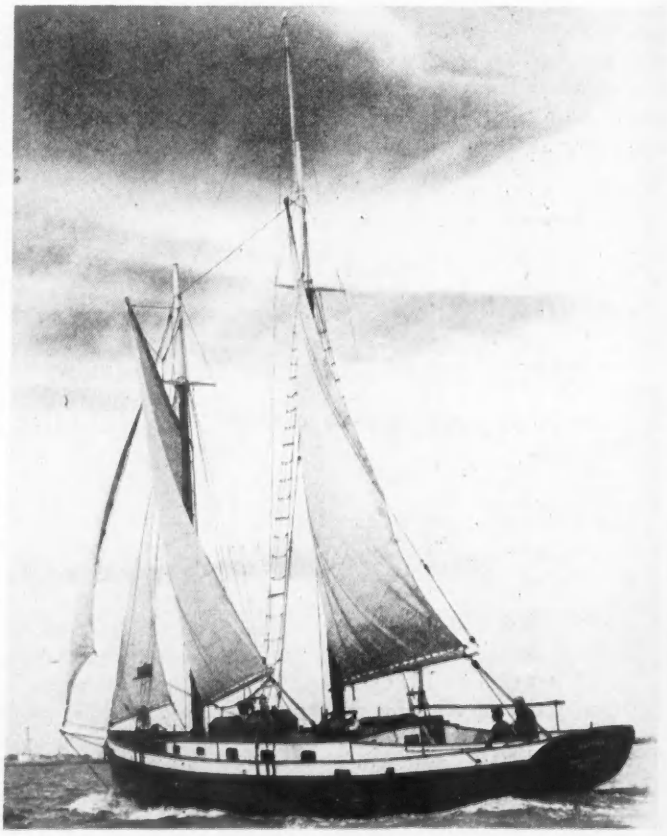
FIGURE 3. Correlation of a seismic recording and an electric log in Hughes County, Oklahoma.

serve as good examples of positive correlation. Here reflections from upper Canyon to Mississippian may be identified on the records. Figure 2 is an example of such a correlation. Contour maps were prepared for horizons A, C, E, and F on this particular prospect. Reflection "D", representing the KMA section, could not be used for mapping since it did not always represent the topmost limestone member. Average velocities for the six recognized horizons are given in Table 2.

Figure 3 shows a correlation made in Hughes County, Oklahoma. Of the seven horizons identified at this location, only the False Mayes, Hunton, and Viola reflections were considered as prominent events. At many locations in this area the sand reflections were poorly developed and weak. The fact that the Union Valley limestone is very near an unconformity in the section may explain the difficulty usually encountered in attempting to map this important marker. Table 3 lists the average velocities obtained from the correlations shown in Figure 3.

In view of the many variables involved in recording seismic events it is not difficult to realize why exact correlation with geological horizons is troublesome. The interpreter and geologist must both be aware of the limitations inherent in seismic methods. The interpreter on the other hand must be sure that he makes use of as much as possible of the information present on each record. Only by a thorough study of the factors involved can successful correlations be made between seismic events and geological horizons.

Gulf of Mexico to Be Studied



To provide basic information on the Gulf of Mexico of value to the petroleum industry as well as other industries, Southwest Research Institute has established a Division of Oceanography and Meteorology. The new division will initiate its studies on the "Harpoon" a two-masted schooner with 900 square feet of sail and a 115-horsepower diesel engine. This oil-screw yacht has an over-all length of 46 feet, beam of 15 feet, 8 inches and registered depth of six feet.

The studies will consider causes and effects of tides and ocean currents, the history, contour, physical structure and natural resources of ocean beds, the shifting topography of the continental shelf area, and conditions affecting types and quantities of marine life. Needed in the work are geologists, chemists, physicists, and biologists, as well as oceanographers and meteorologists.

Establishment of the Division of Oceanography and Meteorology was announced by Dr. Harold Vagtborg, president of the institute, and Dr. Emory N. Kemler, associate director in charge at Houston, who will be in direct charge of the new division's activities.

Can Resistivity Method Discover Oil Directly?

By HUBERT GUYOD
Consultant, Houston

Part 2—Conclusion. ACTUAL DEPTH-RESISTIVITY CURVES

SUPPOSE that the oil reservoir B is not of infinite lateral extent, but that the pool is a horizontal disc of diameter d (Figure 4). It has been found experimentally that the shape of the corresponding depth-resistivity curve remains essentially as shown by Figure 3 so long as the current electrode separation S is less than about one-half the distance d. For greater separations the apparent resistivities are less than shown on Figure 3 because of the current distortion occurring at the edges of bed B, as shown schematically by Figure 4. The resulting depth-resistivity curve is approximately as shown by the solid line of Figure 5. The broken line shown also on this figure represents the curve which would be obtained on the same bed if d were infinitely large.

The departure between the two curves starts approximately for an electrode separation equal to one-half the diameter of disc B, namely for $S = \frac{d}{2}$. For example, if a petroleum reservoir 4000 feet deep has a diameter of 10,000 feet, the departure is observed beyond the point whose abscissa S/D_o satisfies the following relations:

$$S = \frac{10{,}000}{2} \qquad D_o = 4000$$

namely, beyond the point of abscissa 1.25. Therefore, the ordinate of the hump H′ of the solid line curve is appreciably less than that of the broken curve. The greater the depth of bed B, and/or the smaller its lateral extent, the greater the difference between these ordinates. Also, the abscissa of hump H′ is somewhat shifted with respect to the abscissa of H. All these changes obscure the interpretation and reduce the range of applicability of the method since the apparent resistivities are reduced.

Electrode Separation

An experimental depth-resistivity curve made under the conditions illustrated by Figure 1 can be readily interpreted only if the measurements give the characteristic hump. Referring to Figure 3, it is seen that the hump is obtained when the measurements are carried out at least as far as $\frac{S}{D_o} = 7$, namely when the longest electrode separation used is equal to at least seven times the depth of the bed to be located. In practice the resistivity measurements must be made with direct current in order to avoid the skin effect. Because electrode potentials are somewhat unstable, it is not possible to measure accurately the small d.c. potential differences given by very long electrode separations. This limits the applicability of the method to maximum electrode separations of the order of 25,000 feet. Therefore only for petroleum accumulations shallower than approximately 3500 feet will it be possible to obtain the characteristic hump. Without this hump it is impossible to determine what type of resistivity distribution is involved; even if it were known beforehand that the resistivity distribution in the ground is basically of the type shown by Figure 1, one would still have no information whatever on bed B, except the assurance that there is a resistant bed B somewhere in the ground underneath the electrodes at a depth greater than 6S′, S′ being the longest electrode separation used.

Non-Uniformities

Large non-uniformities in bed B do not modify appreciably the depth-resistivity curve provided a weighted average resistivity is considered. A similar remark can be made regarding formation F provided said formation is reasonably uniform. Also, small topographic irregularities can be tolerated. The effect of the foregoing factors is to scatter somewhat the experimental readings about a pre-calculated curve, and the practical result is to lower somewhat the range of applicability of the method.

TABLE 2

Practical minimum resistivity contrast of a petroleum reservoir to stand chance of discovery by the vertical resistivity method, as a function of depth and thickness.

Reservoir Thickness..	5′	10′	20′	30′	50′
Reservoir Depth					
1,000′	80	40	20	13.3	8
2,000′	160	80	40	26.7	16
3,000′	240	120	60	40	24
4,000′	Interpretation difficult				
Greater than 4,000′	Method usually not applicable				

NOTE: Depths and thicknesses are expressed in feet.

To illustrate the present discussion it will be assumed that the effect of these factors is to raise the minimum acceptable contrast number from 0.2 to 0.4. The resulting range of applicability of the vertical method is given in Table 2 which embodies also the limitation caused by the impossibility of using electrode separations greater than 25,000 feet. The effect of the lateral extension of the petroleum accumulation is disregarded in this table because it is difficult to express it simply: this effect would reduce the range of applicability still further.

Table 2 shows that surface resistivity measurements should, in principle, discover many petroleum reservoirs down to depths of about 3500 feet, provided said reservoirs are situated with a reasonably uniform formation.

Suppose for example that the depth-resistivity curve represented on the left side of Figure 6 was experimentally obtained. An inspection of this plot shows that the sediments involved consist essentially of a single resistant bed of relatively small thickness situated within a reasonably uniform formation. Therefore the pre-calculated data of Figure 3 apply to the present case and such data can be used for interpreting the field measurements.

To simplify the following discussion it will be assumed that the bed concerned is of considerably lateral extent.

Referring to Figure 3, it can be seen that the abscissa S/D_o of the humps is always equal to 6, regardless of the contrast number. Since, on the experimental plot, the hump was obtained for an elec-

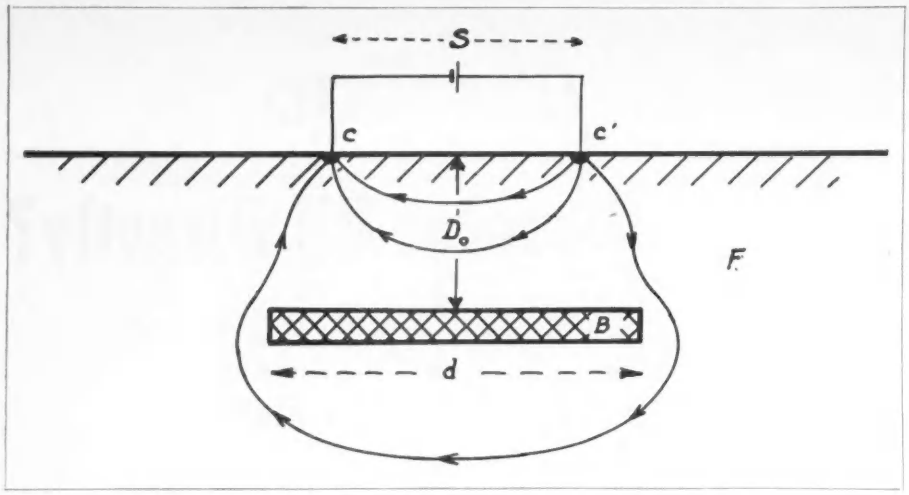


FIGURE 4. Illustration of current distortion caused by edges of oil pool.

trode separation of 1820 feet, the depth D_o of the resistant bed can be determined from the following relations:

$$\frac{S}{D_o} = 6 \qquad S = 1820'$$

namely, the upper boundary of bed B is at 303 feet.

Figure 3 shows also that the ratio of the hump ordinate h to the ordinate y of the asymptotic value of the upper and lower arcs characterizes the contrast number. For the experimental curve this ratio is

$$\frac{h}{y} = \frac{3.8}{3.2} = 1.19$$

Figure 3 shows that the corresponding contrast number is 0.5. Therefore:

$$\left(\frac{R}{R_o} - 1\right)\frac{T}{D_o} = 0.5$$

since $D_o = 303$ and $R_o = 3.2$, we have the following relation:

$$T(R - 3.2) = 485 \qquad (2)$$

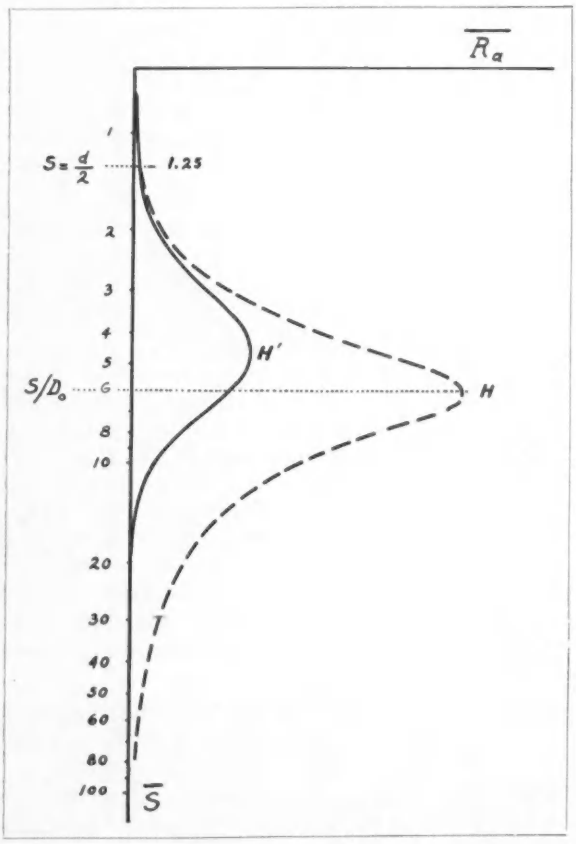
This, unfortunately, is as far as the interpretation can go. In particular the bed thickness cannot be determined, even approximately. The resulting interpretation is represented on the right side of Figure 6.

If other data are available, in addition to the field resistivity measurements it is sometimes possible to obtain limiting values for the bed thickness. For example, if it is known from local experience that the resistivity contrast of the bed is probably comprised between ten and 30, then relation (2) shows that the bed thickness is probably comprised between 5 feet and 16 feet.

The foregoing interpretation of the experimental depth-resistivity curve of Figure 6 has indicated the presence of a resistant bed at a depth of 303 feet. This interpretation, it should be noted, was strictly physical and therefore it does not yield any clue on the geological nature of the resistant bed discovered. This bed may be an oil or gas reservoir, but it may be also a fresh water sand, a dense lime, or any other formation whose resistivity is substantially greater than that of the associated shale. Local experience may sometimes permit identifying the nature of the bed. Such fortunate occurrences are rare and usually the geological interpretation of the experimental data is impossible.

Actual Cases

Notwithstanding the limitations outlined above, the resistivity method is fairly successful in locating the existence and depth of a resistant bed situated within a substantially uniform formation. Unfortunately the formation F represented on Figure 1 is rarely, if ever, uniform enough to permit applying successfully the procedure outlined above. Numerous resistant beds such as fresh water sands, dense lime, etc. . . .



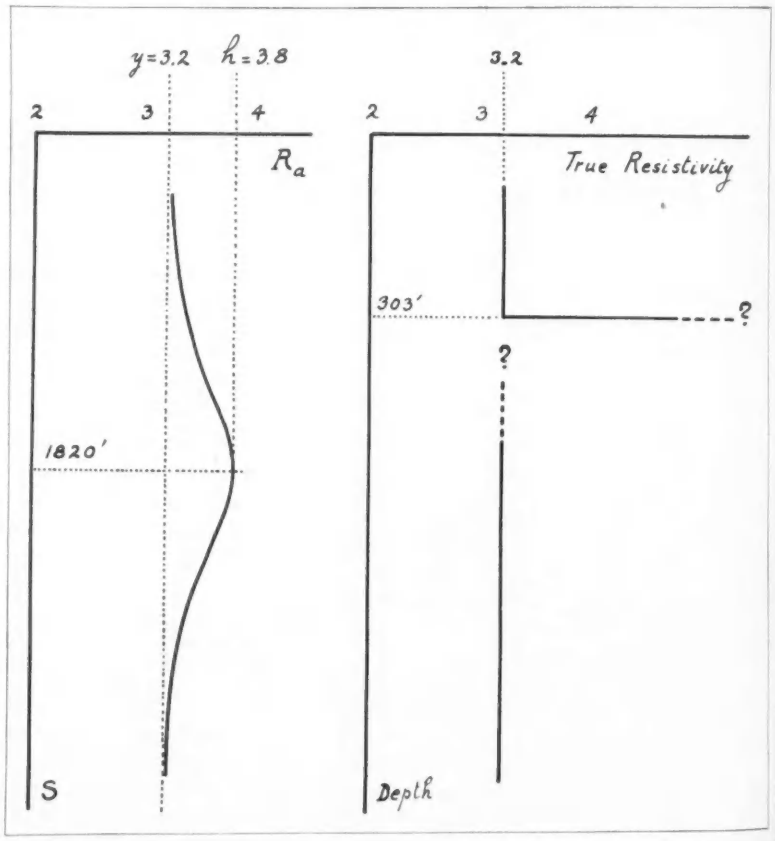


FIGURE 5 (left). Depth-resistivity curve (solid line) for thin resistant bed of finite lateral extent (estimated). Broken line is depth-resistivity curve for same bed, but infinitely extended laterally.

FIGURE 6 (right). Experimental depth-resistivity curve (left) and its physical interpretation (right).

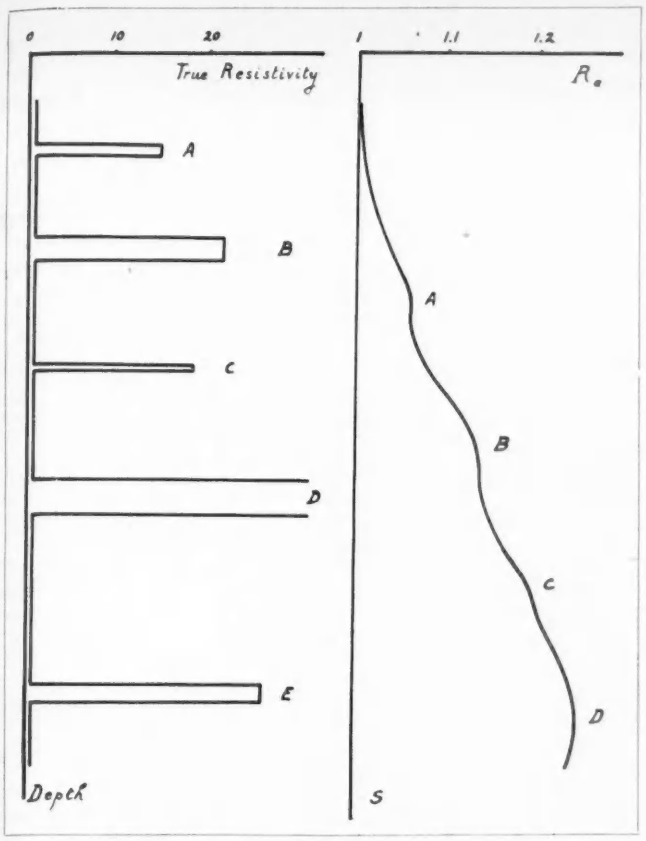


FIGURE 7. Example of complex resistivity distribution (left) and corresponding depth-resistivity curve (right). Data estimated.

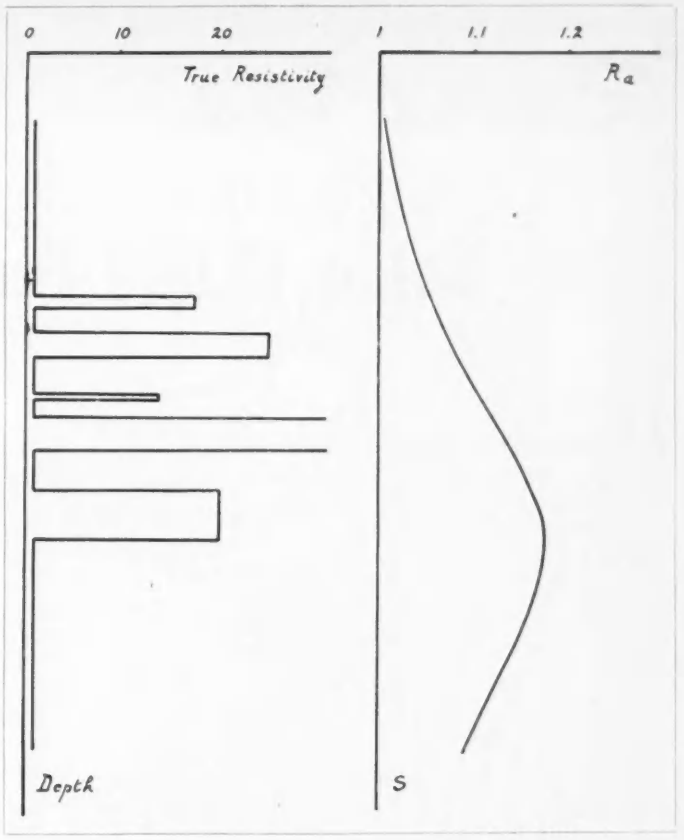


FIGURE 8. Example of complex resistivity distribution (left) and corresponding depth-resisitivity curve (right). Data estimated.

are found above and below a petroleum reservoir. Actual depth-resistivity curves are therefore quite different from the idealized curves of Figure 3. Suppose for example that there are five different resistant thin beds within formation F. Two specific cases will be considered. In the case of Figure 7 the distance between beds is large compared to the bed thicknesses, while in the case of Figure 8 this distance is much smaller. The corresponding depth-resistivity curves are approximately as shown to the right side of the figures.

On Figure 7 each bed is indicated by a small hump on the depth-resistivity curve, but most of these humps do not stand out sharply. Because the field data do not give a continuous curve and also because the difference between the hump ordinates is so small, it usually will be impossible to establish, even approximately, the true resistivity distribution in the ground from the field data. At most only the upper boundary of each resistant bed can be determined, and such determination is a very difficult problem indeed.

On Figure 8, it is not possible to distinguish each bed individually on the depth-resistivity curve. This curve indicates only that there is a zone of relatively high average resistivity within a formation of lower average resistivity. While the upper boundary of this zone can be usually determined from the depth-resistivity curve, no additional information whatsoever can be obtained on the individual beds.

Suppose, however, that through some unusual but fortunate circumstance the true depth-resistivity distribution could be established. The next step would be to interpret the data geologically. The graph to be interpreted would be basically identical to an electric log made in an exploratory well, such log consisting of a single resistivity curve without a potential curve. When it is remembered how impossible it is to interpret correctly this type of data it will be evident that there is no chance of discovering directly a petroleum reservoir with the resistivity method of exploration.

Conclusion

Some of the phases of the preceding discussions have been simplified at the expense of rigor. Also the numerical values selected to illustrate this paper are not representative of all conditions which may be found. This, however, cannot possibly modify the following:

1. Like any other geophysical method of exploration, the resistivity method can be of practical value only if the data can be interpreted, first physically and then, geologically.

2. A physical interpretation of surface resistivity measurements involving a number, even small, of relatively thin beds (i.e. thin with respect to their depth) is usually impossible.

3. Even if the physical interpretation were possible, the geological interpretation of the physical data generally would be impossible.

It is therefore the writer's opinion that surface resistivity measurements cannot discover oil accumulations directly.

The foregoing statement should not be construed as an indication that the resistivity method is useless in oil exploration. On the contrary, this method either alone or as a supplement to other geophysical methods, is frequently of great value when applied to the indirect discovery of oil or gas pools. It is unfortunate that it has met with so little acceptance in this country while it is so successful in the Eastern hemisphere.

The foregoing discussion is based on the assumption that direct current is used for the resistivity measurements, but the conclusions are also valid for alternating current provided a square wave of extremely low frequency is used.

It is sometimes advanced that certain types of waves, such as electromagnetic waves, could be used successfully for detecting directly oil pools. This is extremely doubtful because the conditions are essentially the same as those outlined above: at the frequencies which could be used, the properties of a petroleum reservoir are practically identical to those of fresh water sands, dense formations, etc. At least there is no evidence as yet that, between such properties, there is a difference which can be measured from the surface of the ground, to detect a petroleum reservoir.

Record Well

Below 19,000 Feet

DEEP drilling history is being made in Wyoming where the deepest test in the world, after becoming the first to reach 19,000 feet, is proceeding as though 20,000 or more is its goal. In the last week of April, The Superior Oil Company was drilling below 19,435 feet at Pacific Creek Unit 1, wildcat in Sublette County, Wyoming.

No official forecast has been made by the company as to the ultimate depth to which the test will be carried and no information other than depths has been released. However, rumor has it that 20,000 feet of drill pipe and the same amount of seven-inch casing are at the location, and it is well known that the drawworks and rig equipment were designed to drill to 20,000 feet.

Late reports indicate that drilling is progressing normally. To date, no fishing jobs of consequence have occurred and for the past several weeks drillers have averaged 40 to 45 feet per day. Rock bits are said to be making 50 to 75 feet each and it is reported that a recent round-trip was made in the very good time of ten hours.

The great depth of this test is attracting much attention, but now this is being heightened by speculation on use of the rumored casing, whether for protection or production.

Summary of Results of Exploratory Drilling

ITEM	Mar., 1949	Feb., 1949	THREE MONTHS January-March 1949	1948	Percent Diff.
Oil Discoveries	93	49	216	183	+ 18.0
New Fields	69	34	155	111	+ 39.6
New Pays	24	15	61	72	— 15.3
Distillate Discoveries	12	11	33	23	+ 43.5
New Fields	5	8	17	8	+112.5
New Pays	7	3	16	15	+ 6.7
Gas Discoveries	14	8	31	31	.....
New Fields	14	4	26	20	+ 30.0
New Pays	.....	4	5	11	— 54.5
Total Discoveries	119	68	280	237	+ 18.1
Extensions to Fields	30	21	60	37	+ 62.2
Oil Fields	26	21	56	28	+100.0
Distillate Fields	3	.....	3	5	— 40.0
Gas Fields	1	.....	1	4	— 75.0
Total Prod. Tests	149	89	340	274	+ 24.1
Dry Holes	497	325	1,235	1,093	+ 13.0
Wildcats	486	320	1,217	1,073	+ 13.4
New Pays	2	.....	2	5	— 60.0
Outposts	9	5	16	15	+ 6.7
Total Expl'tory Tests	646	414	1,575	1,367	+ 15.2
Percent Productive	23.1	21.5	21.6	20.0	.....
Percent Dry	76.9	78.5	78.4	80.0	.....

(See tables on Pages 80, 82, 84)

Results of Exploratory Drilling in March and First 3 Months, 1949-1948, by Districts

State or District	MONTH OF MARCH, 1949													FIRST THREE MONTHS, 1949																	
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests								Total Productive		Unproductive Tests				Total Dry		Total Exploratory Tests	
	New Fields			New Pays			Extensions								New Fields			New Pays			Extensions										
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	3 Mo. 1949	3 Mo. 1948	Wildcats	New Pays	Outposts	3 Mo. 1949	3 Mo. 1948	3 Mo. 1949	3 Mo. 1948
Alabama											1			1												2			2	2	2	2
Arizona											2			2												3			3		3	
Arkansas											2			2	1			1						2	2	10			10	16	12	18
California	1			2			4		1	8	33		1	42	3		1	3			6		1	14	6	45		1	46	57	60	63
Colorado											3			3												6			6	15	6	15
Florida											4			4												6			6	4	6	4
Georgia											1			1												2			2	2	2	2
Illinois				1			2			3	26			29	1			5			11			17	17	93			93	91	110	108
Indiana	3									3	26			29	11			2						13	6	88			88	35	101	41
Kansas	5									5	31			36	14		2				2			18	13	83			83	88	101	101
Kentucky											5			5	1									1	2	7			7	6	8	8
Louisiana	7	1	1	4	4		1			18	12			30	10	2	2	6	8		3			31	17	42			42	51	73	68
North Louisiana	2				3					5	4			9	3	1	1		4					9	2	20			20	24	29	26
South Louisiana	5	1	1	4	1		1			13	8			21	7	1	1	6	4		3			22	15	22			22	27	44	42
Maryland																														1	1
Michigan	4						1			5	28		1	34	6		1				3			10	4	82		1	83	55	93	59
Mississippi				1						1	12			13	1			1						2	1	23			23	23	25	24
Montana											1			1											2	6			6	10	6	12
New Mexico				1						1	3			4	1			2						3	8	10			10	16	13	24
Ohio							1			1	7			8							2			2	4	13			13	9	15	13
Oklahoma	3		1	1			4			9	49			58	8	2	1	4		1	6			22	26	101			101	105	123	131
Pennsylvania																										1			1	2	1	2
Tennessee															1									1		5			5	7	6	7
Texas	45	4	10	14	3		10	3		89	223	2	5	319	94	13	16	34	8	4	19	3		191	156	559	2	11	572	481	763	637
Dist. 1 S. Central	4						1			5	28			33	5						1			6	2	66			66	44	72	46
Dist. 2 Middle Gulf	1		2	1						4	16			20	3	5	4	1		1				14	20	38		3	41	47	55	67
Dist. 3 Upper Gulf	2	3		6	2			2		15	22			37	6	4		12	2		3	2		29	20	70			70	58	99	78
Dist. 4 L. Gulf-SW	2	1	3	1	1					8	47	1	2	58	3	2	4	8	4	3				24	24	104	1	4	109	83	133	107
Dist. 5 E. Central								1		1	3			4		1						1		2	4	14			14	18	16	22
Dist. 6 Northeast	2									2	5			7	2	1	1		2		1			6	7	11			11	23	17	30
Dist. 7-B N. Central	15		5	1						21	42	1		64	36		7	4			1			48	37	121	1		122	75	170	112
Dist. 7-C W.Central	1			1						2	5			7	3			1						4	6	9			9	24	13	30
Dist. 8 West	4			1			7			12	14		2	28	8			3			10			21	14	32		2	34	41	55	55
Dist. 9 North	13			3			2			18	40		1	59	27			5			4			36	22	93		2	95	68	131	90
Dist. 10 Panhandle	1									1	1			2	1									1		1			1		2	
Utah							1			1	2			3							1			1		5			5	6	6	6
Virginia																									1						1
West Virginia			2							2				2			3							3	2						3	2
Wyoming	1						2			3	15		2	20	3			3			3			9	7	25		3	28	11	37	18
Total U.S.	69	5	14	24	7		26	3	1	149	486	2	9	646	155	17	26	61	16	5	56	3	1	340	274	1217	2	16	1235	1093	1575	1367

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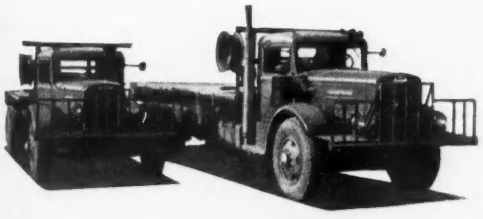

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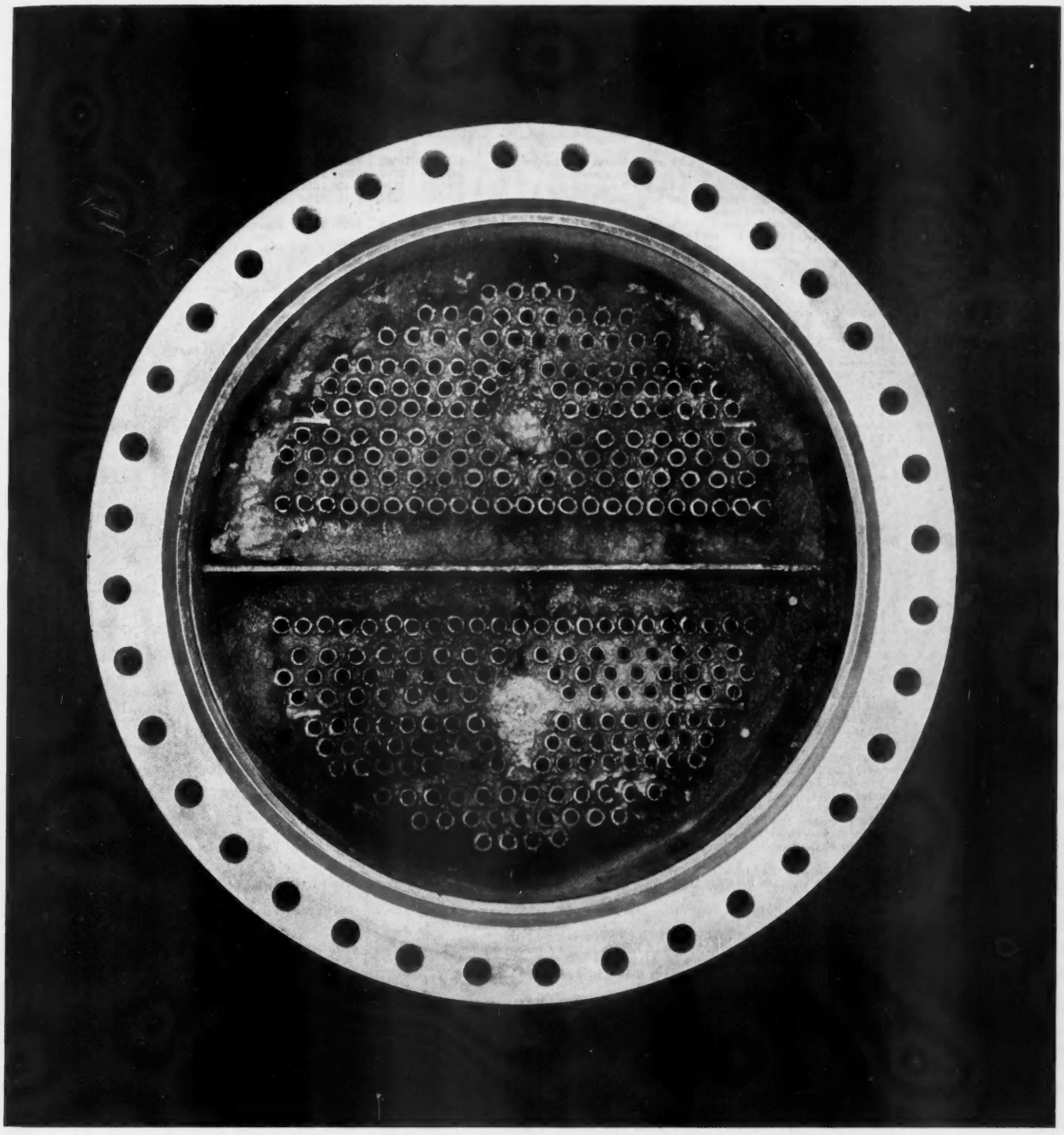
New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in March, 1949

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		CALIFORNIA—New Oil Field						
Kern		Tejon Hills Oil Co's Tejon Hills 13, 14,574 s 22,190 e fr nec Sect. 25-12n-19w in Sect. 10-11n-18w.	3-11-49	665	635- 665		P 50	28
		CALIFORNIA—New Oil Pays						
Ventura	Bardsdale	Cleveland Oil Co's Elkins 4, 537 n 567 e fr w¼c Sect. 7-3n-19w	2-25-49	7493	7488- 7493	Lower Eocene	P 156; 39 wtr	35
Ventura	Rincon	C. C. M. O. Co's Hobson B-100, 2610 s 3917 e fr nwc Sect. 16-3n-24w	3- 2-49	10917	8105-10916		F 46; 7/64"	
		CALIFORNIA—Oil Field Extensions						
Kern	Belridge, S.	Richfield Oil Corp's Cclm 1, 199 s 201 w fr nec Sect. 24-28s-20e, ½ mi nw extension.	3-10-49	1100	934- 1098	Temblor sd; Mio	P 5; 4 wtr	28
Kern	Edison, W.	United Oil Well Supply Co's DeMille-United Drury 1, 1520 n 200 e fr swc Sect. 8-30s-29e, ½ mi n extension.	3-14-49	3512	3198- 3251	Jeppi sd; Mio	P 63; 87 wtr	24
Monterey	San Ardo	Superior Oil Co's Orradre 1, 1111 n 165 e fr swc Sect. 6-23e-11e, ½ mi ne extension.	2-27-49	2569	2382- 2569	Campbell sd; Mio	P 63	11.6
Monterey	San Ardo	The Texas Co's Rosenberg NCT-1-7, 1770 n 3975 w fr sec Sect. 2-23s-10e, ¾ mi nw extension.	3- 2-49	2080	1844- 1968	Campbell sd; Mio	P 107	
		CALIFORNIA—Gas Field Extension						
Solano	Suisun Bay	Standard Oil Co's Honker Comm. 2, 3250 n 500 e fr swc of proj. Sect. 30-3n-1e. ¾ mi se extension.	3- 7-49	7008	6240- 6547	Domengine sd; Eoc	2.3 mln; ¼"	
		ILLINOIS—New Oil Pay						
Clay	Sailor Springs, W.	Magnolia Petroleum Co's E. R. Cambron 3, ne sw ne 15-4n-7e	3-29-49	2980	2833- 2886	Aux Vases sd; Miss	P 8; 39 wtr	
		ILLINOIS—Oil Field Extensions						
Gallatin	Roland	George & Wrather Drlg Co's Meiner 1, nw sw nw 24-7s-8e, 1 mi se ext.	3-22-49	3050	2976- 2986	Rosiclare li; Miss	P 7; 5 wtr	
McDonough	Colmar-Plymouth	D. Lambert's McGinnis 1, nw nw sw 28-4n-4w. ¾ mi s extension	3-29-49	446	440- 445	Hcing sd; Devo	P 3	
		INDIANA—New Oil Fields						
Liberty		Albert R. Snyder's Harriet Evans 1, 330 fr n&wl sw sw sw Sect. 33-26n-7e	2- 5-49	926	867- 926	Trenton sd; Ord	P 14	
Posey		Heppard & Mitchell et al's E. Thomas 1, nw ne se 24-7s-13w, 1 mi se La-Mott pool.	3-15-49	2369	2361- 2366	Cypress sd; Miss	P 80; 25 wtr	
Posey		W. E. Witt & L. L. Blomgren's Walter Whitehead et al 1, ne sw nw 3-7s-12w. 2 mi w Heusler pl & 2 mi ne Stooker pl.	3-31-49	2713	2708- 2712	McClosky sd; Miss	P 160	
		KANSAS—New Oil Fields						
Barton	Hammer, N.	Aladdin & Hannum's Broodie 1, sw sw se 23-19s-12w. 1 mi n of Hammer pl.	3-29-49	3364	3344- 3364	Arbuckle li; Ord	P 511	
Barton	Merten, SE.	B & R Drlg Co. & Wilcox Oil Co's Kuhlman 1, nw sw sw 12-19s-15w. 1 mi se Merten pl.	4- 5-49	3569	3531- 3569	Arbuckle li; Ord	P 121	
Rice	Engelland	Skelly Oil Co's Engelland 1, sw se sw 34-20s-7w	2- 1-49	3353	3335- 3341	Conglomerate	P 50; 116 wtr	
Rooks	Berland, N.	Birmingham & Bartlett's Marcotte 1, se sw nw 18-10s-19w. ½ mi n Berland pl.	3-29-49	3770	3765- 3770	Arbuckle li; Ord	SW 288	
Stafford	Black Cloud	E. H. Adair's Wolf 1, ne ne nw 3-21s-12w. ½ mi s of Workman, SE. pl.	3- 8-49	3435	3415- 3435	Arbuckle sd; Ord	P 189	
		NORTH LOUISIANA—New Oil Fields						
Claiborne		M. A. Halsey & Skelly Oil Co's J. J. Henry 1-A, (OWWO) 1520 fr wl 1120 fr sl Sect. 27-21n-4w 1¼ mi e Lisbon fld.	3-21-49	9091	5225- 5237	Pettit li; L Cre	F 720; ½"	34.8
Sabine		Lawrence Potter & William Spillisy's Long Bell Lbr. Co. 1, c se nw sw Sect. 6-8n-13w. 3 mi s Sardis.	3-20-49	3252	1998- 2060	Chalk	P 120	40.2
		NORTH LOUISIANA—New Distillate Pays						
Caddo	Longwood	Phillips Pet. Co's Hammack 1, 1332 fr nl 1176 fr el Sect. 6-18n-16w	1- 1-49	9428	8162- 8196	Cotton Valley sd; Jur	F 159; ¼"	65.8
Claiborne	Haynesville,E	Hunt Oil Co's S. W. Owens 1, 1842 fr sl 2037 fr el Sect. 13-23n-7w. 1½ mi n & 3 mi e of prod.	3-26-49	11701	8588- 8600	Cotton Valley (Tucker) sd; Jur	F 277; 2.9 mln; ¼"	62
Webster	Sibley	Sam E. Wilson, Jr's T. Crichton et al 1, 2080 fr el 660 fr sl Sect. 34-18n-9w.	3- 7-49	5700	5502- 5520	Glen Rose sd; L Cre	F 230; open	
		SOUTH LOUISIANA—New Oil Fields						
Jefferson	Manila Village	Tidewater Assoc. Oil Co's State Lse 1299-1, 5407 s 4373 e of USC&GS Sta. "St. Denis 3" in Sect 25-18s-24e. 7 mi s of Lafitte fld.	3-21-49	13050	12980-13036		F 157; 3/32"	39
Lafourche	Bay Marchand	The California Co's Louisiana State Lse. 1366-1, Blk 2, Marchand Prospect area in Gulf of Mexico.	3- 7-49	3741	2873- 2892		F 255; ½"	26.7
Livingston	Springville	Danciger O&R Co's Myrtle E. Smiley 1, sw sw 9-7s-5e, 1½ mi nw Springville, 15 mi ne Hallets Bayou fld.	2-15-49	8748	8006- 8007	Catahoula sd; Mio	F 109; 3/32"	43.5
Plaquemines		Shell Oil Co. Inc's State Lse 1355-1, 660 w&s of nec of Blk 80, n of pass a Loutre in Gulf of Mexico.	3- 8-49	5835	5835- 5842		F 111; 165 wtr; 11/64"	27.9
Terrebonne		Humble O&R Co's Timbalier State Lse, Acct. 1-1, 660 fr e&sl of Tr. 1176, Blk 34, 10 mi s of Timbalier Island in Gulf of Mexico.	3-29-49	9926	9550- 9558		F 456; 3/16"	39.6
		SOUTH LOUISIANA—New Oil Pays						
Cameron	Little Chenier	Gulf Refining Co's Mermentau Mineral & Ld Co., Inc. 1, 660 s&w of nec Sect. 14-14s-6w s of gas-dist prod.	3- 5-49	13260	10422-10428		F 289	37.2
Iberia	Weeks Island	Shell Oil Co's Smith-State Unit 4-B, 8177 n 4098 e of USC&GS Sta. "Weeks 2", nwc of Sect. 18-14s-6e.	3-26-49	14900	14015-14025		F 410; 3/32"	34
Lafourche	Bay Marchand	The California Co's Louisiana State Lse. 1367-2, Blk 2, Gulf of Mexico	3-14-49	5703	5020- 5066		F 320; 3/32"	40.9
Pointe Coupee	Fordoche	The Texas Co's Cleland W. Dearing et al 2, 660 n&e fr nwc of Sect. 20-6s-8e	3-23-49	9037	8607- 8614		F 206; 3/32"	39.9
		SOUTH LOUISIANA—Oil Field Extension						
Beauregard	Hurricane Creek	W. E. Walker's Fee 1, 660 w&s of nec of Sect. 33-5s-8w, ½ mi sw extension	3-18-49	8630	8375- 8405	Cockfield sd; Eoc	F 108; 3/64"	47
		SOUTH LOUISIANA—New Distillate Field						
Vermilion		Hassie Hunt Trust's J. S. Broussard 1, 660 w 288 n of c of Sect. 6-14s-1e,	3-22-49	12636	12098-12106		F 70; 11/64"	43
		SOUTH LOUISIANA—New Distillate Pay						
St. Martin	Arnaudville	The Union Sulphur Co. Inc's Hefea Land Co. 1, 3396.3 n 1564.9 w of the nec of Sect. 15-8s-5e, in Sect. 38.	3- 8-49	11700	11059-11078		F 27; 2.5 mln; 3/16"	47
		SOUTH LOUISIANA—New Gas Pay						
Terrebonne	Bay Baptiste	Union Producing Co's State-Bay Baptiste Unit 2, 1730 s 925 e of nwc of Sect. 46-19s-19e, 1½ mi sw of prod.	3-29-49	12749	8955- 8968		4.2 mln; ¼"	
		MICHIGAN—New Oil Fields						
Allegan		Norman L. Stevens' Rivard 1, se sw nw 31-1n-15w, Lee Twp	3-25-49	1172	1171- 1172	Traverse sd; Devo	P 230	41
Gladwin		Socony Vacuum Oil Co. Inc's Wolverine Power Co & Arehart 1, sw se se 2-17n-1e, Billings Twp.	3-31-49	3558	3435- 3558	Dundee li; Devo	P 20	
Kalamazoo		Ashby O&G Co's Williams et al 1, nw ne Sect. 30-1s-21w, Alamo Twp	3- 4-49	1314	1310- 1312	Traverse sd; Devo	P 10	
Oceana	Mears	McClanahan Oil Co & Geo F. Herr's Dykstra 1, ne se ne 34-15n-18n,	3-11-49	2211	2210- 2211	Dundee li; Devo	F 252	
		MICHIGAN—Oil Field Extension						
Bay	Adams	Ervin Major's McQuarrie 1, (OWDD) nw nw nw 1-18n-3e, Gibson Twp., 1 mi sw extension.	3-25-49	4262	4239- 4250	Richfield sd; Devo	P 50	
		MISSISSIPPI—New Oil Pay						
Franklin	Roxie	Vaughey & Vaughey & Big Chief Drlg Co's J. M. Seab 1, 666 n 667 e of swc sw se 12-6n-2e, 1½ mi n of prod.	3-14-49	10882	10703-10705	Massive sd; U Cre	F 71; 5/32"	40.2
		NEW MEXICO—New Oil Pay						
Lea	Cross Roads	Mid-Continent Pet Corp's U. D. Sawyer 1-B, 660 fr nl 1980 fr wl of Sect. 34-9s-36e.	3-23-49	12750	12376-12460	Mississippi sd; Miss	F 210; open	44
		OHIO—Oil Field Extension						
Muskingum	Brush Creek	Chartiers Oil Co's J. T. & Mary Leach 1, sw nw Sect. 20, Highland Twp.	3- 1-49	4660	4540- 4550	Clinton sd; Sil	Sw 5	
		OKLAHOMA—New Oil Fields						
Garvin	Lindsay, SE	Max Pray & Elisha Walker, Jr's Pratt 1, ne ne se 20-4n-3w	3-17-49	10228	7294- 7312	Gibson sd; Penn	F 130; 3/8"	41
Logan		James H. Snowden et al's Fry 1, c nw nw 4-18n-4w, betw Marshall & Lovell flds.	3-10-49	4962	4054- 4059	Tonkawa sd; Miss	F 100	
Pottawatomie		Bert Aston's Neal 1, ne se ne 30-6n-3e	3-31-49	4625	3110- 3124	Layton sd; Miss	P 35	
		OKLAHOMA—New Oil Pay						
Pawnee	Keystone	Toklan Prod. Co's Peterman 1, nw ne nw 24-20n-9e	3-24-49	2324	2319- 2321	Burgess sd; Penn	F 164	35



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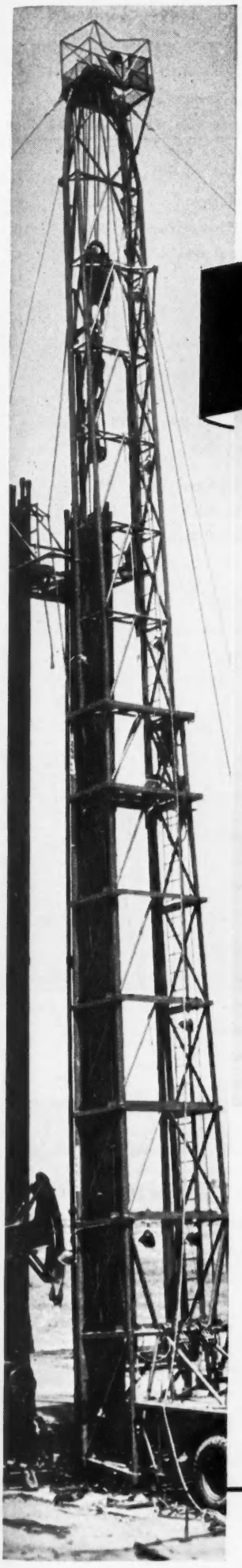
New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in March, 1949—Continued

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		OKLAHOMA—Oil Field Extensions						
Garvin	Linday, E.	Sohio Pet. Co's H. K. Moore et al 1, c nw nw 17-4n-3w. se extension.	4- 7-49	10685	9630- 9656	1st Bromide sd; Ord	F 635; 4/16"	42
Hughes	Fish, E.	Davidor & Davidor's Joe Moore 1, se ne ne 4-6n-8e. s extension.	3-24-49	2799	2779- 2799	Booch sd; Penn	P 40	37
Love	Stockton	Cox & Hamon's Stozier 1, se se ne 27-6s-2w. w extension.	3-31-49	7250	6985- 7014	Pennsylvanian	P 132	35
Payne	Mt Hope, NW.	The Texas Co's State School Land 1-L, ne ne se 36-9n-3e. ½ mi s extension.	3-10-49	3754	3711- 3754	Red Fork sd; Penn	F 112; 7/16"	39
		OKLAHOMA—New Gas Field						
Seminole		Sohio Pet. Co's Ragland 1, sw se nw 31-5n-6e.	3-17-49	1836	1806- 1826	Pennsylvania sd; Penn	8 mln	
		TEXAS—District 1 (SOUTH CENTRAL)—New Oil Fields						
Caldwell		Riddle Oil Co's A. J. Miears 1, 2400 fr nel 3200 fr sel of C. M. Cannon Sur.	3- 1-49	1980	1881- 1924	Dale li; U Cre	P 2	
Dimmitt		Continental Oil Co's Ewell McKnight et al 1, 1050 fr nel 330 fr sel of Mills M. Battles Sur. 3 mi sw of Carrizo Springs.	3-10-49	3333	2555- 2569		P 24	44.3
Frio	Big Foot	Shell Oil Co. Inc's Travis W. Bain 1-A, 1980 fr el 1320 fr sl of John Bruggeman Sur. 4 mi s of Big Foot.	1- 1-49	3280	3211- 3280	Navarro sd; U Cre	P 8	44
Travis	Lund	Anderson-Prichard Oil Corp's G. E. Johnson 1, 330 fr ne&sel of Lot 12, Pedro Rodriquez Sur. 6 mi nw of Elgin.	3-14-49	1009	982- 996		P 40	34
		TEXAS—District 1 (SOUTH CENTRAL)—Oil Field Extension						
Frio	Big Foot	Miller Royalty & C. C. Dauchy's C. R. Thompson 1, 330 fr n&el of s½ of F. Boyer Sur. 1½ mi se extension.	2-17-49	3299	3282- 3299	Navarro sd; U Cre	P 20	43.7
		TEXAS—District 2 (MIDDLE GULF COAST)—New Oil Field						
Bee	Rudman	Rudco O&G Co & Rock Hill Oil Co's McFall Kerbey et al 1, 467 fr n&el of Thos. B. Reese Sur. 4 mi w-nw of Yoward fld.	2-20-49	7554	7019- 7025		F 100; 3/8"	27
		TEXAS—District 2 (MIDDLE GULF COAST)—New Oil Pay						
Victoria	Coletto Creek	Fidelity Oil & Royalty Co's William Dietzel 3, R. Manchola Sur.	3-20-49	4912	4332- 4337	Frio sd; Olig	F 145; ½"	24.3
		TEXAS—District 2 (MIDDLE GULF COAST)—New Gas Fields						
Bee		P. R. Rutherford's Claude E. Heard 2, 5200 fr nl 3500 fr el of Jeremiah Tool Sur. 7 mi ne of Skidmore.	3- 4-49	5138	3474- 3490		5.2 mln open	
Victoria		Jergins Oil Co's Katie Willemin 1-2, 330 fr sel 1263 fr nel of Lse, Pedro Gallardo Gr., ½ mi s of Coletto Creek, S. Oil fld.	2-28-49	5186	4522- 4525		0.7 mln ½"	
		TEXAS—District 3 (UPPER GULF COAST)—New Oil Fields						
Polk		R. H. Abercrombie's W. A. Crum 1, 466 fr nwl 33 fr nel of 40-ac Lse, A. Viesca Lge, 2 mi se of Goodrich, 1 mi w Goodrich fld.	3-13-49	7792	7116- 7123	Wilcox sd; Eoc	F 200; 8/64"	38.2
Chambers	Oyster Bayou, S.	Sun Oil Co's Felix Jackson 30, 1980 fr el 2500 fr sl of T&NO Sur, Sect. 125, 1¼ mi s of Oyster Bayou fld.	2- -49	10250	9543- 9546	L Frio sd; Olig	no gge	
		TEXAS—District 3 (UPPER GULF COAST)—New Oil Pays						
Brazoria	Manvel	The Texas Co's J. L. Lemmer 6, (OWWO), 330 fr nwl 2310 fr swl of Sect. 39, Thos Spraggins Sur.	3-30-49	5730	4543- 4548		F 69; 5/32"	26.8
Fort Bend	Big Creek	The Texas Co's Perryman S. Moore et al 1, 600 fr nel 75 fr nwl of 100-ac Lse, Barnabus Wickson Sur.	3-30-49	4322	3540- 3546		F 49; ¼"	29
Hardin	Saratoga	D. D. Feldman's S. F. Bashara 3, 500 fr nl 330 fr el of 100-ac Lse, J. B. Reeves Sur.	3- 2-49	7501	7390- 7485		F 274; 11/64"	34.3
Harris	Humble, S Flank	Caroline Hunt Tr. Est.'s Martha O'Connor 3, 225 fr nl 325 fr el of J. Dunnan Sur.	3- 9-49	3592	3556- 3566	Cook Mountain sd; Eoc	F 81; 8/64"	39.6
Liberty	Hull	Houston Prod. Co's Alpha A. Hiemple 2-B, 175 fr sl 300 fr el of 80-ac Lse, T. Trahan Sur., on nw flank.	3-31-49	8027	7187- 7204		F 499; ⅛"	31.2
Wharton	Mach	Lloyd H. Smith & McKay Donkin's Kate Poucher 1, 330 fr nl 466 fr el of sw¼ of Sect. 26, Mark Weiss Sur.	3- 3-49	6822	6394- 6398	Frio sd; Olig	F 117; 8/64"	37.9
		TEXAS—District 3 (UPPER GULF COAST)—New Distillate Fields						
Austin		Gulf Oil Corp's Adolph Weige 1, 168-ac Lse, James Tylee Sur, 1 mi n of New Ulm fld.	2- -49	11071	9668- 9690		P 127; no gge	
Chambers	Oyster Bayou, N.	Sun Oil Co's Middleton 1-A, 1320 fr sl 660 fr el of Sect. 81, E. Moss Sur, 1 mi nw of Osyter Bayou fld.	3-18-49	9707	9207- 9210	L Frio sd; Olig	F 24; 1.7 mln; ¼"	48.1
San Jacinto		Butcher-Arthur, Inc's John A. Jones 1, 5500 fr el 3250 fr nl James Rankin, Jr. Sur, 1 mi sw Cold Spring fld.	3-15-49	8364	4492- 4496	Frio sd; Olig	F no gge; 2.2 mln; 4/16"	
		TEXAS—Distrcit 3 (UPPER GULF COAST)—New Distillate Pays						
Colorado	Altair	Superior Oil Co's Pryor 1-A, (OWWO), 800-ac Lse, BBB&C Sur.	3- 5-49	8399	8194- 8208	U Wilcox sd; Eoc	F 35; 14/64"	64.5
Liberty	Hankamer, NW Flank	McCarthy O&G Corp's E. W. Boyt 1, 330 fr wl 660 fr nl of Sect. 22, H&-TC Sur.	3-15-49	8058	8007- 8021	Vicksburg sd; Olig	F 26; 7.7 mln; ¼"	44.1
		TEXAS—Distrct 3 (UPPER GULF COAST)—Distillate Field Extensions						
Brazoria	Old Ocean	Abercrombie & Magnolia Pet. Co's Mrs. Etta A. Brockman 1, John Cummings Lge, 1½ mi s extension.	2- -49	11055	10911-10922	Larsen sd; Olig	F 240; 8.6 mln; ¼"	
Brazoria	Pledger	Humble O&R Co's Pledger Gas Field Unit 4, Jas. Hensley Sur, across San Bernard River from prod.	2-25-49	6872	6783- 6792	Frio sd; Olig	F 6; 0.9 mln; ¼"	47.9
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—New Oil Fields						
Hidalgo		Continental Oil Co's A. B. Watson et al 1, La Lomita Irrig. & Constr. Co. Subd. of Porc. 63, Blk 131, 1½ mi n of McAllen.	2-15-49	8504	6946- 6962		F 16; 8 Wtr ¼"	33.3
Starr	Gregg Wood	D. G. Wood, Sr's Fee 1, 237 fr wl 11,944 fr sl 4000 fr nl of 700-ac Lse, Porc. 84, 4 mi ne of Rio Grande City.	2- 4-49	1321	1315- 1321		P 23	22
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—New Oil Pay						
Neuces	Bailey	Producers Development Co's Louis Bailey 2, Lot 20, Sect. 36, Agua Dulce Fm Lots, ½ mi nw prod.	1- 6-49	6040	5960- 5967		F 102; 3/32"	38
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—New Dist. Field						
Brooks		Amerada Pet. Corp's Concepcion Garza Zamora 1, 660 fr n&el of Blk 5-H, Sh. 4, H. Brooks Sbdn., 3 mi ne of Falfurrias.	3-30-49	8610	7352- 7356		F 44; 1.2 mln; ¼"	52.7
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—New Dist. Pay						
Duval	Government Wells, N.	Ralph E. Fair, Inc. & Jack Woodward's J. Luptak 1, 330 fr sl 580 fr el of J. Poitevent Sur. 41.	3- 1-49	10506	7660- 7728	Wilcox sd; Eoc	F 95; 2 mln; 8/32"	
		TEXAS—District 4 (LOWER GULF-SOUTHWEST)—New Gas Fields						
Duval		J. W. Gorman et al's Worden-Drought 1, 330 fr w&nl of Jaun L. Saen Sur,	2-23-49	2231	1832- 1850		27 mln; open	
Duval		M. L. Massingill & American Republics Corp's Brigidia Garcia et al 1-A, 1463 fr sl 1590 fr el of Sur, 142, 1 mi sw of Chiltipin fld.	3-21-49	4995	3268- 3276		1.8 mln; open	
Hidalgo		Sun Oil Co's F. R. Barrera 1, 900 fr nl 3800 fr el of El Benadito Gr.	3- 9-49	6205	4630- 4638		4.8 mln; open	
		TEXAS—District 5 (EAST CENTRAL)—Dist. Field Extension						
Freestone	Steward Mill	Carter-Gragg Oil Co's O. B. & Ruby Utley 1, 330 fr nl 544.4 fr wl of J. S. Claypool Sur. 1 mi s extension.	3-19-49	4052	4009- 4019	Woodbine sd; U Cre	F 30; 3.4 mln; open	
		TEXAS—District 6 (NORTHEAST)—New Oil Fields						
Marion		Arrow Drlg Co's Mrs. Mary E. Rice 2, 467 fr sl 267 fr wl of 57-ac Tr., John Hanks Sur, ne of Jefferson.	3-19-49	7173	6045- 6050	Dees-Young sd; L Cre	P 86; 12 wtr	41
Smith	"Red Springs"	Humble O&R Co's Everett Wintters et al 1, 467 fr sl 3530 fr w'ly wl of Wm. Price Sur, 5¾ mi nw of Winona.	3-15-49	10409	9368- 9404	U Rodessa sd; L Cre	F 321; ¼"	44
		TEXAS—District 7-B (NORTH CENTRAL)—New Oil Fields						
Brown		W. R. Seed's Horace E. White 1, 150 fr swl 1548 fr sel of 200-ac Lse, J. S. Thom Sur. 53.	2-10-49	1597	1572- 1597	Ranger li; Penn	P 5	36.6
Coleman		Coe Oil Co's John W. Harris 1, 150 fr n&el of w 50-ac of Blk 10, John Sanders Sur, 162, 3 mi n Burkett.	3- 9-49	395	389- 395		P 10	39
Coleman	"Goat Hill"	Woods Drilling Co's J. P. McCord 1, 330 fr wl 480 fr sl of w part of Eliza Yancy Sur. 158, 3 mi n Glen Cove.	3- 8-49	3310	3300- 3308	Fry sd; Penn	F 108; 4/16"	44
Eastland		Brackeen Oil Co & Rudco O&G Co's E. D. O'Rear 1, 1699 fr nl 990 fr wl of s 516-ac of Sect. 6, Blk. 2, ETRR Sur, 5 mi e Rising Star.	2- 5-49	2866	2811- 2821	Marble Falls li; Penn	P 12; 2 wtr	39.8
Eastland		R. W. Fair's Kent 1, 330 fr nl 479 fr wl of e½ of Lot 14, T. J. Fennell Sur, 6 mi nw Rising Star.	2-25-49	3659	3116- 3126	Marble Falls li; Penn	P 23	40
Eastland		J. M. M'Melveny et al's N. T. Mulloy 1, 990 fr el 660 fr sl of Wm. Ahrenbeck Sur. 2, 7 mi nw Rising Star.	2-25-49	3714	3024- 3040	Marble Falls li; Penn	P 2	40.3
Eastland		R. N. Patterson et al's W. H. Davis 1, 3700 fr wl 2100 fr nl of J. L. Schoonover Sur, 2 mi ne Desdemona.	2-18-49	3241	3207- 3241		P 22	42
Shachelford		G. E. Kadane & Sons' Merrick Davis 1-A, 330 fr n&wl of e½ of Sect. 23, Blk 12, T&P Sur, 6 mi sw Albany	3-13-49	4987	4722- 4732	Bend cgl; Penn	P 12	41
Shachelford		H. F. Pettigrew's T. C. Moore 1, 330 fr n&wl of Sect. 1560, TE&L Sur, 6½ mi e Albany.	3- 6-49	4495	4483- 4490	Ellenburger li; Ord	P 29	43.6



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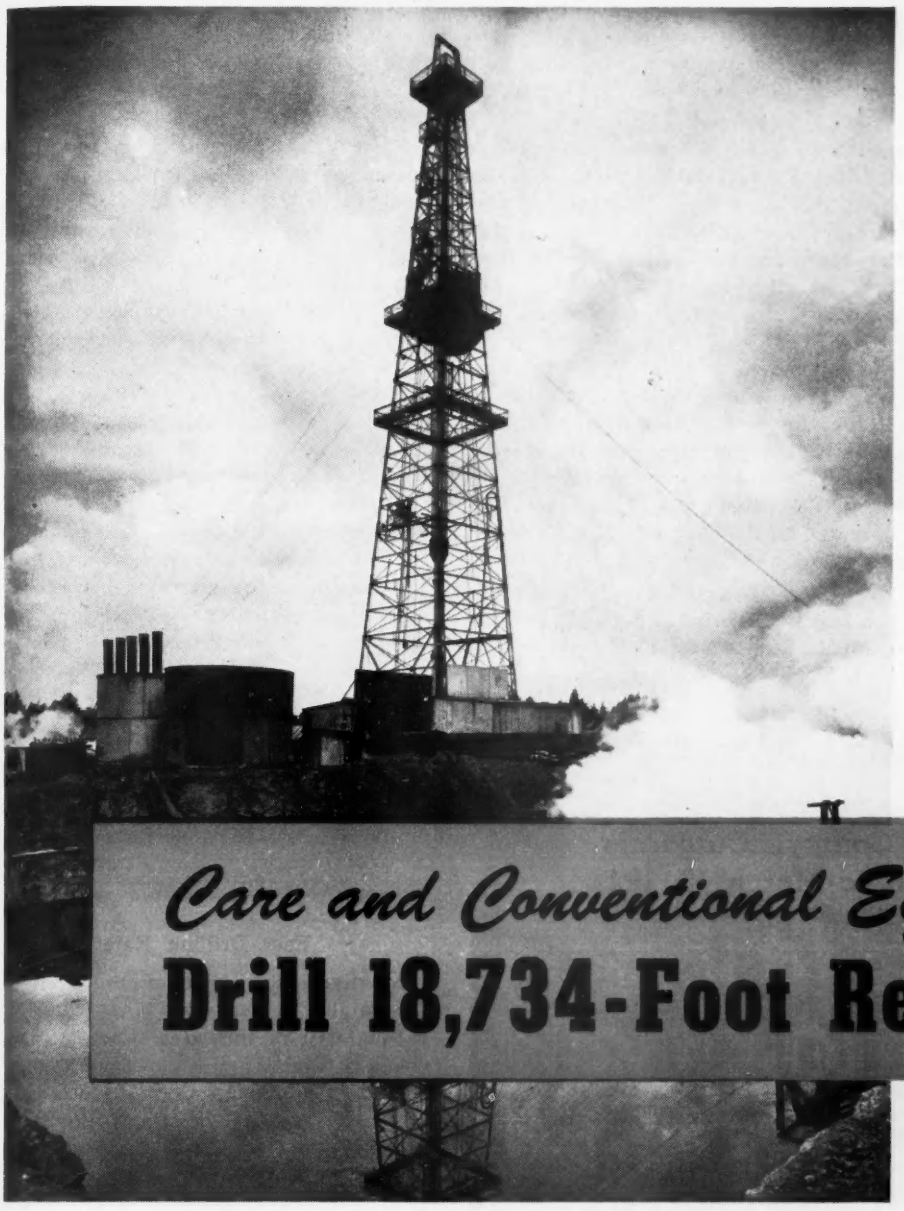
New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in the United States in March, 1949—Continued

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
Stephens		Bond Oil Co & Prairie O&G Co's J. B. Sloan et al 1, 330 fr n&el of Sect 1161, TE&L Sur, 1½ mi n Crystal Falls.	3-24-49	4310	4283- 4310	Mississippi li; Miss	F 792; ½"	43
Stephens		McElroy Ranch Co's J. Barker et al 1, 1128 fr sl 1577 fr wl of Sect. 3, Blk 8, T&PRR Sur. 5 mi w Breckenridge.	3-23-49	4488	4463- 4488	Ellenburger dolo; Ord	F 65; 11/64"	44.2
Taylor		Anderson & Word et al's K. H. C. Barnhart Hrs. 1, 8778 fr el 200 fr sl J. Gray Sur, 3 mi se Lawn.	2-16-49	4047	4034- 4049	Gray sd; Penn	F 21; ¼"	45
Taylor		Twin Oil Corp. et al's City of Abilene 1-B, 500 n 330 w of nwc of Sect. 22, in Sect 82, Blk 14, T&P Sur. 3 mi ne of Abilene.	3- 8-49	1679	1673- 1679	Saddle Creek sd; Penn	P 216	40.1
Throckmorton		Kriss & Schwartz's M. Daws 2, 590 fr nl 330 fr el of C. W. Marques Sur, 12 mi sw Throckmorton.	3-15-49	2822	2808- 2822	Canyon sd; Penn	F 480; ¾"	41.7
Wise		R. B. Thrift, Tr's W. O. Blocker 1, 330 fr nl 150 fr wl of W. A. Gorman Sur, Blk G, 1½ mi s Chico, W. fld.	3- 2-49	5560	5494- 5522	Caddo cgl; Penn	F 227; ½"	43
		TEXAS—District 7-B (NORTH CENTRAL)—New Oil Pay						
Jones	Fragosa	C G & C Co's Hoke-Propst 1, 522 fr sl 2395 fr wl of M. Fragosa Sur 267	3-19-49	2586	2562- 2586	Flippen sd; Penn	P 95	40
		TEXAS—District 7-B (NORTH CENTRAL)—New Gas Fields						
Coleman		J. H. Dunn et al's Mrs. Hattie Bennett et al 1, 660 fr s&wl of Blk 3, HE& WT Sur, 4 mi e Santa Anna.	2-20-49	2234	2135- 2199	Caddo li; Penn	3.9 mln; open	....
Eastland		Luling O&G Co's J. G. Rump 1, 467 fr n&wl of se¼ of Sect 25, D&DA Lands, 8 mi sw Gorman.	3-25-49	2898	2564- 2590	.....	6 mln; open	
Palo Pinto		W. K. Gordon's W. J. Langford 1, 2650 fr nl 604 fr el of Sect. 59, Blk 3, T&P Sur, 8 mi nw Gordon.	3-29-49	3658	3654- 3658	.....	2.5 mln; open	....
Shackelford		Honolulu Oil Co's F. C. Pool 1, 330 fr s&wl of Blk 35, University Lands, 1 mi nw Moran.	3-30-49	5276	2005- 5010	Palo Pinto sd; Penn	4.3 mln; open	....
Stephens		McElroy Ranch Co's L. P. Martin et al 1, 1456 fr el 656 fr sl of Sect 1509, TE&L Sur, 10 mi w Breckenridge.	3-16-49	4410	3428- 3474	Caddo li; Penn	24.2 mln; open	....
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Fields						
Upton	"Pegasus"	Magnolia Pet. Co's TXL 1-A. 660 fr n&wl Sect 31, Blk 40, T-4-S, T&P	3-15-49	13295	12700-12760	Ellenburger dolo; Ord	F 975; ½"	53
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Pay						
Reagan	Benedum	Plymouth Oil Co's Joe S. Elliott 1, 660 fr s&el Sect 46, Blk Y, MK&T Sur.	2- 8-49	10618	10584-10618	Bend li; Penn	F 257; ½"	52
		TEXAS—District 8 (WEST)—New Oil Fields						
Borden	South Gail	H. L. Hunt's Clayton & Johnson 1, 1980 fr nl 660 fr wl Sect 24, Blk 31, T-4-N, T&P Sur, 5½ mi s Gail.	2- 7-49	8015	6490- 6496	Wolfcamp li; Perm	P 19	35
Midland	Tex Harvey	Tex Harvey Oil Co's Mrs. B. W. Floyd et al 1, 2000 fr nl 660 fr el Sect 16, Blk 37, T-3-S, T&P Sur, 13 mi se of Midland.	2-24-49	12063	7865- 8055	Clear Fork sd; Perm	P 135; 13 wtr	40.2
Pecos	Abell, NW	George T. Abell's E. A. Hall 1, 6270 fr sl 330 fr el Sect 21, Blk 9, H&GN	3-13-49	6010	5487- 5500	McKee sd; Ord	F 180; ¼"	42
Terry	Mount Lake	Seaboard Oil Co's E. M. Hinson 1, 660 fr n&wl Sect 91, Blk 4-X, ELRR	3-10-49	11848	9405- 9455	Pennsylvania sd; Penn	P 150; 20 wtr	43
		TEXAS—District 8 (WEST)—New Oil Pay						
Cochran	Landon	Stanolind O&G Co's J. F. Edwards 2, Sect 13, Blk L, PSL Sur.	3-26-49	10955	10913-10955	Devonian sd; Devo	F 237; 8/16"	38.4
		TEXAS—District 8 (WEST)—Oil Field Extensions						
Andrews	Shafter Lake	Gulf Oil Corp's University 1-KK, 330 fr s&el of Sect 14, Blk 13, Univ. Lds. Sur. ½ mi w extension.	3-14-49	8550	8485-8550	Wolfcamp li; Perm	F 381; ½"	41.3
Dawson	Welch	Cities Service Oil Co's Lillian Scanlon 1-B, 660 fr sl 1980 fr el Sect 87, Blk M, EL&RR Sur, w extension.	3- 1-49	4952	4825- 4950	San Andres li; Perm	P 116; 5 wtr	33.3
Ector	Cowden, S	Guy Mabee's L. K. Colbert 1, 1980 fr nl 660 fr el Sect 41, Blk 42, T-2-S, T&P Sur, ¾ mi e extension.	3-23-49	4720	4580- 4705	Grayburg li; Perm	F 105; 2"	33
Pecos	Lehn	Condor Pet. Corp's M. D. Self 1, 330 fr s&el Sect 36, Blk 10, H&GN Sur, ¾ mi s extension.	3- 5-49	2020	1940- 1950	Queen sd; Perm	F 41; ¼"	35
Pecos	Abell	Ellis A. Hall's Ester Abell 1, 330 fr s&wl of Lot 1, Sect 22, Blk 9, H&GN	2-25-49	5500	5478- 5500	McKee sd; Ord	F 432; ¼"	42
Pecos	Pecos Valley-High Gr	Sawnie Robertson's Atkins & Keeney 1, 990 fr nl 330 fr wl Sect 24, Blk 10, H&GN Sur, n extension.	2-27-49	1644	1620- 1630	Yates sd; Perm	F 30; 2"	34
Pecos	Pecos Valley-High Gr.	Darrell W. Smith's Iowa Realty Tr. 1, 330 fr swl 2310 fr nwl of Sect 31, Blk 10, H&GN Sur, ½ mi ne extension.	3- 3-49	1564	1547- 1564	Yates sd; Perm	F 41; ¾"	38.3
		TEXAS—District 9 (NORTH)—New Oil Fields						
Archer		H & H Enterprises' W. Duckworth 1, 1745 fr nl 1400 fr wl of Blk 7, Jno W. Harris Sbdn, 8 mi ne Megargel.	3-12-49	1397	1388- 1397	Gunsight li; Penn	P 44	....
Archer		Featherstone-Spragins-Riner & Ward & McCullough's W. C. Thomas 1, 330 fr. s&el Blk 2, N. Thomas Sur, 2 mi nw Archer City.	3-15-49	3729	3718- 3722	Strawn sd; Penn	P 72	42.7
Archer		Tom B. Medders' Margaret Smith Hancock 1-A, 330 fr sl 2388 fr wl of Sect. 7, Blk 1, H&TCRR Co. Sur, 1½ mi s Vogtsberger fld.	3-29-49	3871	3857- 3867	Strawn sd; Penn	F 337; 21/64"	42
Archer		The Texas Co's L. F. Wilson 1-C, 1500 fr sl 2100 fr wl of SPRR Sur, Sect 1, 1½ mi e Reno-Strawn fld.	3- 9-49	5437	3740- 3783	Strawn sd; Penn	F 89; ¼"	....
Archer		The Texas Co's T. B. Wilson 1-G, 1100 fr n&el of H. H. Kirk Sur,	3-19-49	1690	1619- 1623	.....	P 62	40
Archer		O. C. Willis' B. D. Ikard 1, 1243 fr nl 1716 fr wl of Sect 1889, TE&L Sur, 8 mi sw Windthorst.	3-25-49	993	991- 993	Gunsight li; Penn	P 18	....
Clay		L. T. Burns' S. L. Fulghman 1, Blk 44, J. H. Belcher Sbdn, 1½ mi w Joy fld.	3-18-49	4509	4474- 4509	Strawn sd; Penn	F 240; ¼"	43
Clay		W. R. Dillard's W. Holt 1, 990 fr sl 844 fr wl of Blk 4, J. H. Belcher Sbdn. 1½ mi se Burns-Browning fld.	3-25-49	4497	4490- 4497	Strawn sd; Penn	P 65	....
Jack		Jack Grace Prod. Co's L. L. Campsey 1, 467 fr el 852 fr sl of J. M. Hudson Sur, 9 mi n Jacksboro.	3-29-49	6231	5492- 5504	Conglomerate	F 219; ½"	60
Jack		Mid-Continent Pet Corp's W. N. Killen 1, 990 fr n&wl of B. Lewis Sur, 3 mi sw Post Oak.	3-14-49	3850	3792- 3795	Strawn sd; Penn	P 93	41.7
Jack		Warren Oil Corp's C. O. Tilghman 1, 330 fr nl 941 fr el of Blk 4, Navarro CSL, 1½ mi ne Matlock fld.	3- 6-49	5408	5386- 5408	Mississippi li; Miss	F 845; 23/64"	44.4
Montague		Tex Harvey Oil Co's Beulah Capps 1, 721 fr nl 467 fr wl of Blk 81, John H. Belcher Sur, 2 mi s Belcherville.	3-18-49	5853	5586- 5601	Caddo cgl; Penn	P 36	42
Montague		The Texas Co's Guerin 1, 1150 fr sl 2700 fr wl MEP&PRR Sur, 2 mi se Capps Corner fld.	3- 5-49	4038	2600- 2633	Strawn sd; Penn	P 54	....
		TEXAS—District 9 (NORTH)—New Oil Pays						
Archer	Archer Co. Regular	L. T. Burns' D. L. Bishop 2, 330 fr s&wl of Blk 52, Meade L M Pasture Sbdn.	3-25-49	5135	4644- 4648	Caddo li; Penn	F 481; 8/16"	43
Clay	Amos & Andy	Fain & McGaha's F. S. Fulgham 1, 330 fr nl 990 fr el of Blk 59, J. H. Belcher Sbdn, ¾ mi sw fr prod.	3- 9-49	4492	4487- 4492	.....	P 126	42
Young	Young Co.Reg	Hunter Bros.' Kunkel Est. 1, 550 fr nl 467 fr el of Sect 174, TE&L Sur	3-29-49	3371	3358- 3371	Strawn sd; Penn	F 1061; ¾"	41.2
		TEXAS—District 9 (NORTH)—Oil Field Extensions						
Jack	"Cherry-homes"	Walter L. Plemons Prod. Co's T. H. Cherryhomes 1, 3500 fr sl 5000 fr wl of Thos. Burbridge Sur, ½ mi e extension.	3-22-49	4703	4680- 4703	Bend cgl; Penn	F 257; ½"	42
Montague	Bowers	S. D. Johnson et al's Sarah Geurin 1, 330 fr sl 450 fr wl of se¼ T. Puckett Sur, 1½ mi se extension.	3-27-49	2573	2553- 2573	Strawn sd; Penn	P 86	....
		TEXAS—District 10 (PANHANDLE)—New Oil Field						
Roberts		Sinclair Prairie Oil Co's C. S. Lips 1, Sect 135, Blk C, G&M Sur	3-31-49	9555	8900- 8970	Mississippi sd; Miss	F 517; 2"	35
		UTAH—Oil Field Extension						
Uintah	Ashley Creek	Rogers Lacy Estate's W. E. Rennie 1, ne ne ne 26-5s-22e, ¾ mi se Extension	3-15-49	4255	4231- 4355	Weber sd; Penn	F 30	....
		WEST VIRGINIA—New Gas Fields						
Raleigh		Hope Natural Gas Co's Arch Mankin 9320, Trap Hill District	3-17-49	1621	1604- 1620	Ravencliff sd	1.6 mln; open	....
Wyoming		United Producing Co's W. A. Ritter Lumber Co. 79-1574, Baileysville District.	3-17-49	1939	1907- 1935	Salt sd; Penn	1.6 mln; open	....
		WYOMING—New Oil Field						
Fremont		Atlantic Ref. Co's Tribal 1, e sw sw 25-1s-4e, Riverton Area.	3-22-49	11884	11666-11832	Tensleep sd; Penn	F 384; ¾"	46.3
		WYOMING—Oil Field Extensions						
Weston	Fiddler Creek	Trigood Oil Co et al's Thompson 1, se sw sw 13-46n-65w, 1¼ mi nw extension	3-11-49	4572	4565- 4572	Newcastle sd; U Cre	F 890; ½"	....
Weston	Mush Creek	Morton Oil Co's Borgailli 1, nw sw sw 26-44n-64w, 1½ mi sw extension	3-11-49	4962	4924- 4960	Newcastle sd; U Cre	F 74	43

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formations abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke given in inches.



The 176-foot derrick, with 32-foot base and 11-foot substructure, was of the extended leg type, and had a capacity of 980,000 pounds. It was equipped with a seven-sheave, 600-ton crown block and a 104-inch travelling block, both grooved for 1¼-inch drilling line. To a depth of 10,000 feet, 3-inch x 55-foot rubber rotary hose was used, but from there to bottom, two 4½-inch x 55-foot steel hoses were employed.

Care and Conventional Equipment

Drill 18,734-Foot Record Well

THE SUPERIOR OIL COMPANY'S Ventura County, California, wildcat not only established a depth record of nearly 3.55 miles, but also broke all existing records for time required to pass all of the recent markers. The handling of equipment by the crews and the close scrutiny of items which might have caused trouble enabled the record to be made with a nine-year-old rig with minimum expense. Highlights of the record job are presented, with depth-time curve and sample wireline data, all pointing to the excellent performance of men, materials and equipment.

By GILBERT M. WILSON
Staff Writer

CLOSE supervision, constant checking of drilling mud, examination of drill pipe and drill collar threads whenever possible, frequent pulling over and removal of worn drilling line, and careful drilling . . . these are but a few of the elements which, combined, made it possible for The Superior Oil Company to establish a world record depth of 18,734 feet in its Limoneira No. 1 wildcat near Montalvo, Ventura County, California. Site of the well was approximately six miles east of the city of Ventura. The well was spudded in September 6, 1948.

In breaking its own world record depth established in 1947 when the Caddo County, Oklahoma, wildcat Weller 51-11 reached a total depth of 17,823 feet, the company achieved several marks of distinction. The Montalvo project is considered to have established a record in the speed of drilling, the total time from grassroots to total depth amounting to 191 days. It is probably the cheapest deep well to have been drilled, total cost amounting to approximately $500,000. In addition, it is one of the straightest holes ever drilled to a record depth, the maximum deviation in any one direction amounting to only three degrees. The hole was abandoned

March 18, 1949, without having encountered shows of oil or gas.

Conventional Equipment

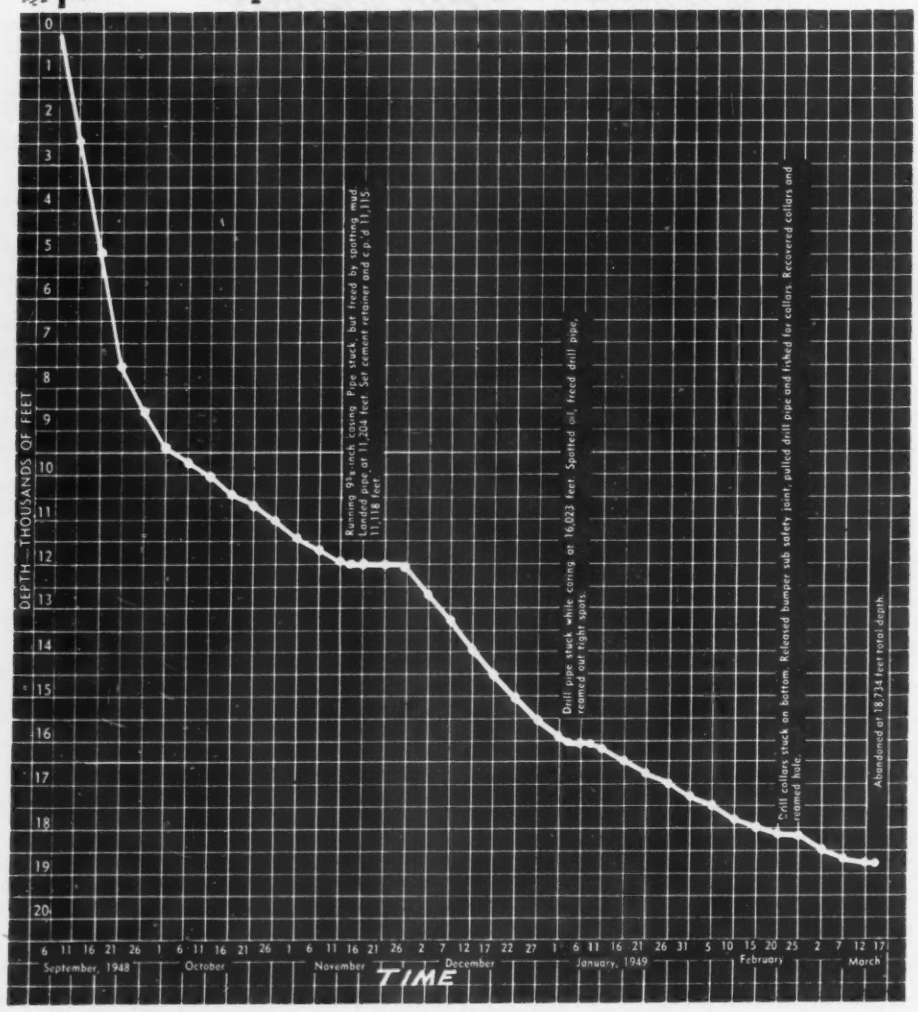
Equipment used on the well was for the greater part of conventional type. The rig was nine years old, and had been used on numerous 10,000- to 13,000-foot drilling jobs. The derrick, of the extended leg type, was 176 feet high, having a 32-foot square floor and 11-foot sub-structure. It had a rated capacity of 980,000 pounds. The derrick was set on steel plate footings anchored to a reinforced concrete mat. The main drawworks was powered by a 15 x 16 twin steam drilling engine designed to operate on 500 pounds of steam pressure. It was equipped with air-operated second speed clutch, 40-inch double hydromatic brake, and an automatic breakout cathead. At the time it was placed in service in March, 1940, the drawworks was considered to have the largest drum made. Grooved for 1¼-inch line, the drum had ample capacity for the ten to 12 lines that were strung up during the later stages of the drilling. The 600-ton, seven-sheave crown block and 104-inch travelling block were of heavy-duty type. A 5 9/16-inch by 54-foot hexagonal kelly was used.

The 20½-inch fully enclosed, oil-bath lubricated rotary table was shaft-driven by a 12x12 steam engine which also powered a standby drawworks, the latter being located on the derrick floor opposite the main drawworks. The standby drawworks, the throttle and reverse of which were operated by hydraulic remote control, served not only as a standby unit, but also as storage for new drilling line, which was fed into the system periodically as worn line was pulled over and removed at the main drawworks. A sand reel was mounted on the back side of the standby drawworks.

Two 13 3/8-inch blowout preventers, the lower one being a double gate unit, were used on the well. They were set on a 13 3/8- by 9 5/8-inch casing head.

DEPTH-TIME CURVE

The Superior Oil Company's Limoneira No. 1, Ventura County, California, September 6, 1948, to March 18, 1949


DEPTH - THOUSANDS OF FEET
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Running 9⅝-inch casing. Pipe stuck, but freed by spotting mud. Landed pipe at 11,304 feet. Set cement retainer and c.p.'d 11,115-11,118 feet.
Drill pipe stuck while coring at 16,023 feet. Spotted oil, freed drill pipe, reamed out tight spots.
Drill collars stuck on bottom. Released bumper sub safety joint, pulled drill pipe and fished for collars. Recovered collars and reamed hole.
Abandoned at 18,734 feet total depth.
6 11 16 21 26 1 6 11 16 21 26 1 6 11 16 21 26 2 7 12 17 22 27 1 6 11 16 21 26 31 5 10 15 20 25 2 7 12 17
September, 1948
October
November
December
January, 1949
February
March
TIME

Power operated slips were used throughout the drilling of the well. From surface to 10,000 feet, 3-inch by 55-foot rubber rotary hose was used, and from there on, 4½-inch by 55-foot steel hoses were used.

Steam was generated by five 150-horsepower, 500-pound working pressure welded type boilers. These boilers, domeless and fully insulated, were equipped with superheaters and stack blowers. Three 500-pound 10 x 6¼ x 10 feedwater pumps supplied the boilers with water treated by four water softener units.

Slush pumps consisted of two 15½ x 9¼ x 22 units and one 14½ x 7½ x 18 mud-mixing pump, all steam driven. Under normal drilling conditions, only one mud pump was used, the two units being compounded only when extraordinary pressures or volume were required, such as during the several minor fishing jobs which occurred. While drilling the last several thousand feet of hole, pumps were operated at from 18 to 19 strokes per minute and at from 1600 to 1800 pounds per square inch pressure. Below 18,000 feet, the pump discharge liners were reduced to 7¾-inch size. The mud circulating system included two electric motor-powered shale shakers and two 200-barrel capacity all-welded steel suction tanks.

Fast Drilling Rate

Relatively low cost of the well is attributable in part to the easy digging encountered in this area. Lack of mechanical trouble, outside of several comparatively minor instances of stuck pipe, also contributed to the speed with which footage was made. Considering total elapsed rig time, the well was drilled at at average rate of 98 feet per day. From about 16,000 feet on down to bottom, drilling rate averaged just under 40 feet per day, this period, however, including a four-day loss of time caused by a fishing job which occured at 18,136 feet. When it is realized that a single round trip at 18,000 feet required approximately 11 hours, that rock bits were changed on an average of about every 80 feet of hole from 12,000 feet on down, and that spot coring and running of electric log at various times consumed still more time, this rate of drilling may be considered as exceptionally good. Average footage for actual drilling time was slightly more than eight feet per hour.

The hole size and casing program in the well were conventional. The well was spudded in with 12¼-inch hole which was carried to 1975 feet, after which it was reamed to 17½ inches. A string of 13⅜-inch, 54.5- and 61-pound surface casing then was run in and cemented with 1700 sacks.

From there to 12,030 feet, 12¼-inch

Wilson

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WITH SENSATIONAL NEW Air Control

- **FOR DRILLING WELLS TO 4000 FT. WITH 4½" DRILL PIPE.**
- **FOR SERVICING WELLS TO 8000 FT. WITH 2½" TUBING.**
- **FOR SERVICING WELLS TO 16000 FT. WITH 2½" TUBING (using 15" Double Rotor Hydromatic Brake).**

Complete rig on one skid! Full panel air control! Incomparable in its rated capacity class for portability! WILSON MOGUL TORCAIR RIGS incorporate the advanced AIR CONTROL and adjusted TORQUE APPLICATIONS of the larger WILSON RIGS . . . it is particularly designed for deep well servicing, and like all WILSON machines, it does the job like a thoroughbred. Compactly built with large air compressor and air tank, it measures less than 8 feet overall width, with catheads removed. WILSON Air-Tube Clutches in the drum; automatic feed brake enables the driller to set brake and leave it in one position. Numerous other features worth looking into! Write for Bulletin 174 — it's just off the press!

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MANUFACTURING CO., Inc.
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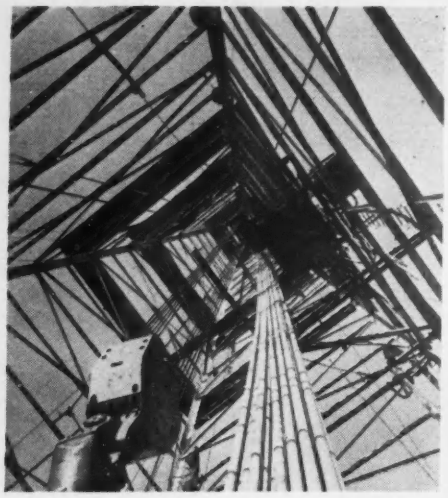
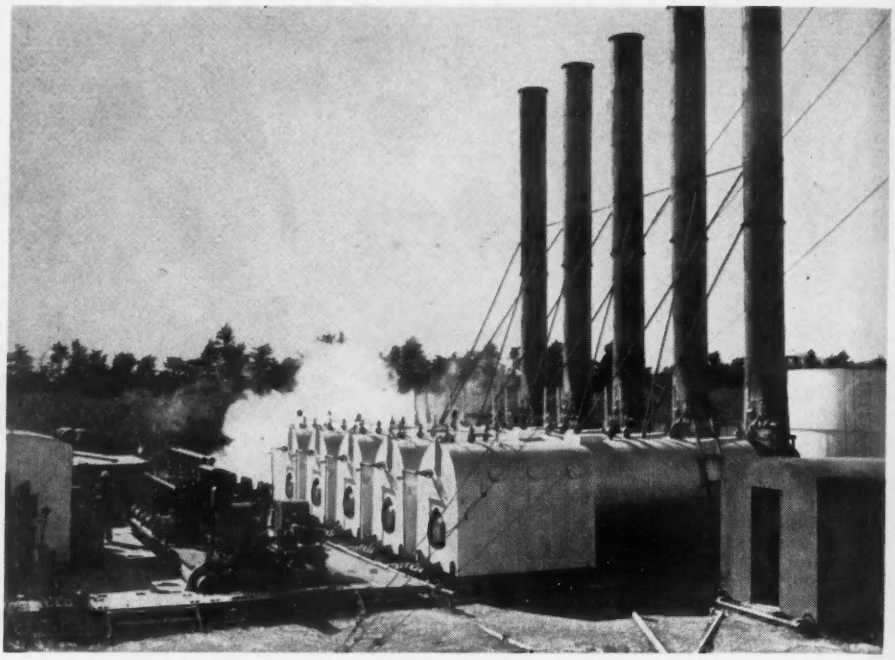


From surface to 1979 feet, 5 9/16-inch drill pipe was used to drill and ream 17½-inch hole. From there to 12,030 feet, 4½-inch pipe was used to drill 12¼-inch hole. After 9⅝-inch casing was cemented at 11,204 feet a new string of 4½-inch, 18.10-pound, Grade E, Range 2 drill pipe was used to drill 8⅜-inch hole to 17,400 feet. At this depth, 12,200 feet of the 4½-inch was retained and enough 3½-inch, 15.50-pound Grade E, Range 3 pipe added to reach to bottom. The use of the tapered string from there to total depth lightened the load by about 7½ tons.



Power for drilling operations was generated by five 500-pound working pressure, all-welded type boilers. They were gas fired and equipped with stack blowers. Boiler-feed water was supplied by three 10 x 6¼ x 10, 500-pound working pressure pumps, the latter unitized and skid mounted. Four water softening units supplied treated water to the boiler feed water system.

hole was drilled, a string of 9 5/8-inch, 53.5- and 47-pound seamless casing equipped with wall scratchers and centralizers then being run in. The string froze at several points on the way down, but in each case was freed by spotting of mud or oil, until it reached a depth of 11,204 feet, at which point it could not be lowered any further. A cement retainer was set at 11,095 feet and ten holes were shot between 11,115 and 11,118 feet, after which a squeeze job was performed. Cause of the casing sticking, and the several instances of drill pipe sticking is believed to have been the existence of several intervals of unconsolidated sands, these formations tending to slough in and cause trouble from time to time. From 12,030 to total depth of 18,734 feet, 8 3/8-inch hole was drilled.

Three sizes of drill pipe were used. From surface to 1979 feet, 5 9/16-inch, 22.5-pound, Grade D, Range 3 drill pipe, equipped with API full-hole tool joints, was used to drill and ream the 17½-inch hole. From there to 12,030 feet, 4½-inch, 18.10-pound, Grade E, Range 3 pipe equipped with 6½-inch, flash-welded tool joints, was used to drill the 12¼-inch hole. A new string of 4½-inch, 18.10-pound, Grade E, Range 2 drill pipe was brought in after the 9 5/8-inch casing was cemented at 11,204 feet. Equipped with 6⅛-inch shrink-thread tool joints, this string was used to drill the 8⅜-inch hole from 12,030 to 17,400 feet. At the latter depth, 12,200 feet of the 4½-inch drill pipe was retained and enough 3½-inch, 15.50-pound Grade E, Range 3, pipe was added to reach bottom. This tapered string resulted in a lightening of the load by about 2600 pounds per thousand feet, or a total weight saving of about 7½ tons.

Much Care Exercised

To a depth of 12,204 feet, approximately 300 feet of 7¾-inch by 40-foot drill collars were used. After drilling out the 9 5/8-inch shoe, approximately 250 feet of 6 1/8-inch by 40-foot drill collars were carried in the string to a depth of 18,136 feet. At this point, the drill collar size was reduced by using approximately 240 feet of 5¾-inch by 30-foot drill collars on the string. Drill pipe and drill collar threads were examined frequently, the latter being broken out from time to time solely for the purpose of inspecting threads. In several instances, bad drill collar threads were found, and the prompt laying down of the affected collars probably saved expensive fishing jobs or even loss of the hole.

Other tools used on the well included overshots which were kept on the rig at all times on a standby rental basis; a releasing type bumper sub and safety joint which was carried continuously in the string while drilling below 9000 feet; and a set of rotary jars which was used in the string while drilling below 17,159 feet.

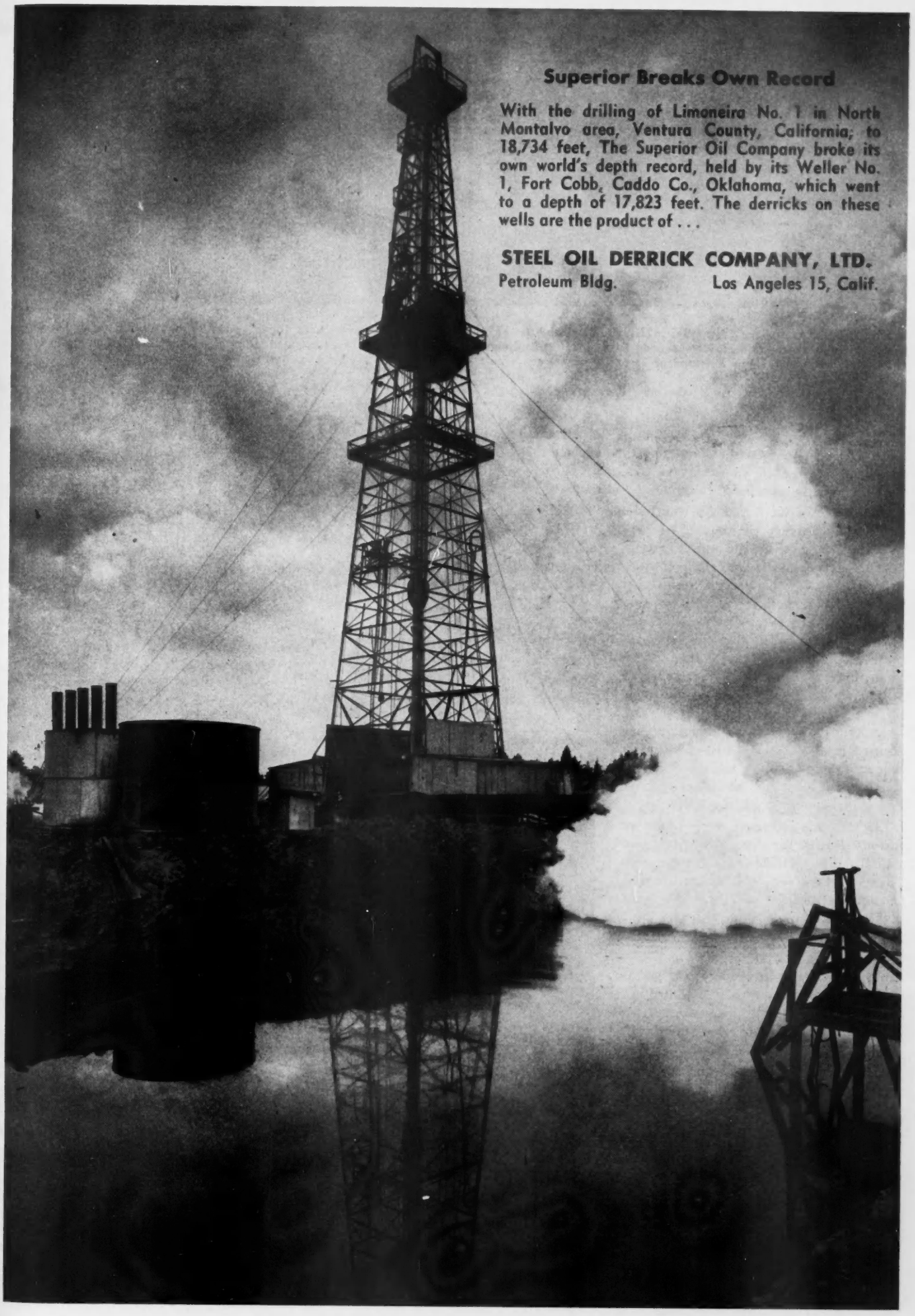
It was while drilling at 18,136 feet that the most serious fishing job occurred. Drill collars became stuck near the bottom of the hole. After repeated working of the pipe and spotting of oil in the hole without success, the bumper sub was released and the drill pipe pulled, leaving the drill collars, with lower half of the safety joint attached, in the bottom of the hole. With a set of drill collars installed on the bottom of the string to give needed weight at that point, the drill pipe was re-run and the bumper sub safety joint re-attached to the half still on the fish. After a few upward pulls and jarring of the fish, the stuck collars were pulled free.

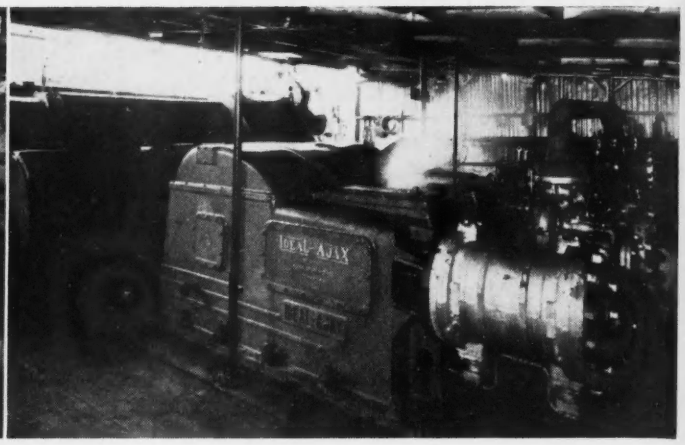
TABLE 1
Wire Rope Service Record

SPOOL SIZE	Depth Used	Round Trips	Ton Miles of Service	Feet of Line Cut	Remarks. Amount of Wear Shown
3000 ft.	14,985—16,023	14½	7740	....	Hemp center. Replaced by IWRC rope.
3200 ft.	16,023–17,017	20½	11,663	525	IWRC rope.
3200 ft.	17,017–17,992	15	9,252	375	IWRC rope. No great amount wear shown when removed.
3300 ft.	17,992–18,623	11½	7,453	625	IWRC rope. Showed only slight flattening of strands.

Rock Bit Record

Rock bits and rock bit core heads were used exclusively in the well. In the 12¼-inch hole, from surface to 12,030 feet, 87 bits and five core heads were


Superior Breaks Own Record
With the drilling of Limoneira No. 1 in North Montalvo area, Ventura County, California, to 18,734 feet, The Superior Oil Company broke its own world's depth record, held by its Weller No. 1, Fort Cobb, Caddo Co., Oklahoma, which went to a depth of 17,823 feet. The derricks on these wells are the product of . . .
STEEL OIL DERRICK COMPANY, LTD.
Petroleum Bldg. Los Angeles 15, Calif.



LEFT: Fluid ends of the two 15½ x 9¼ x 22 mud pumps and the 14½ x 7½ x 18 mud mixing pump. Under normal drilling conditions only one mud pump was used, the units being compounded only when extraordinary pressures or volume were required. During the last several thousand feet of drilling, pumps were operated at 18 to 19 strokes per minute and at 1600 to 1800 pounds per square inch discharge pressures.

RIGHT: Rear view of the main drawworks showing the 15 x 16, 500-pound working pressure steam twin drilling engine.

used. From there to bottom, in drilling the 8 3/8-inch hole, 84 rock bits and 15 core heads were used. Conventional coring equipment was used throughout.

Twenty cores were taken in the hole, yielding a recovery of about 53.4 percent. Coring rate averaged approximately 3.4 feet per hour. The deepest core to be taken in the well was in the interval between 18,711 and 18,721. A few side wall cores were taken in the 12¼-inch hole at a time when drilling had progressed to a depth of 16,731 feet. These cores, taken at about 12,000 feet, revealed a mud wall cake thickness of one inch, a few of them containing all mud cake. That the 12¼-inch hole diameter had been reduced by at least two inches after four months of drilling was of considerable interest inasmuch as an 8⅜-inch bit was being run through the hole.

Electric log surveys were made at various depths, the deepest run being to a total depth of 18,734, which represents a world record for depth in the running of such instruments.

The maximum accumulated deviation of the hole in any one direction was three degrees, or about 400 feet, this being considered by many to be an excellent record in straight hole drilling. Deviation was only 1.5 degrees at 16,660 feet. No directional surveys were run.

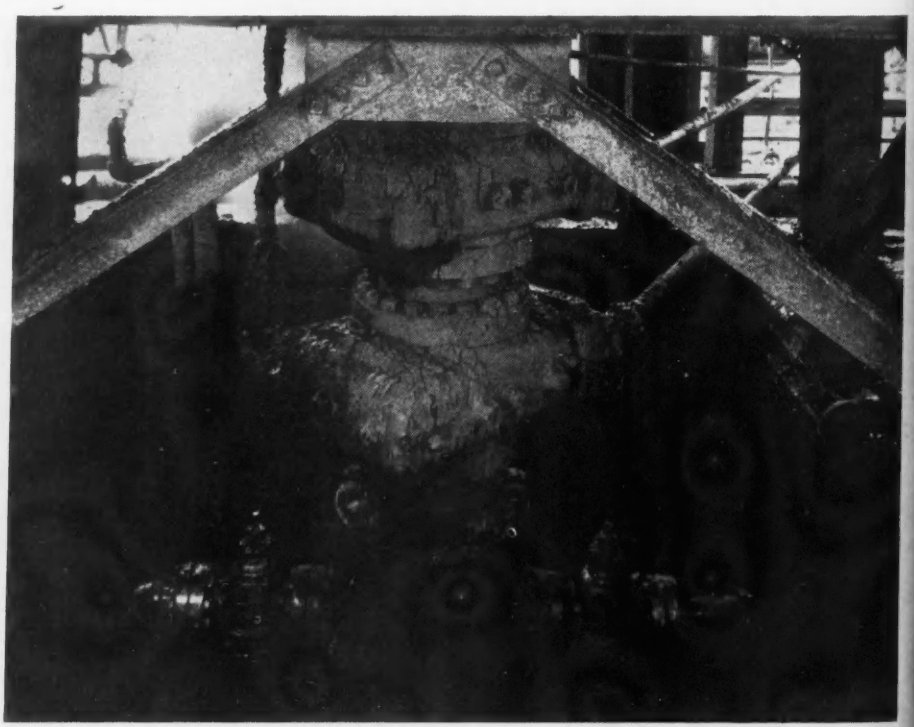
Low Bottom-Hole Temperatures

Remarkably low bottom-hole temperatures were encountered, the maximum being 260° F. recorded with the electrical logging device at total depth of 18,734 feet. Temperature gradients based on wells drilled in adjacent areas, and considered to be typical for this region, indicate a normal temperature of around 340 degrees should have been found in this well. A possible reason for this discrepancy may be that the high rate of circulation of cooled mud from the surface might have cooled the formation by perhaps 80 to 90 degrees in the immediate vicinity of the well bore. Temperature of mud returns ranged from 130 to 135° F.

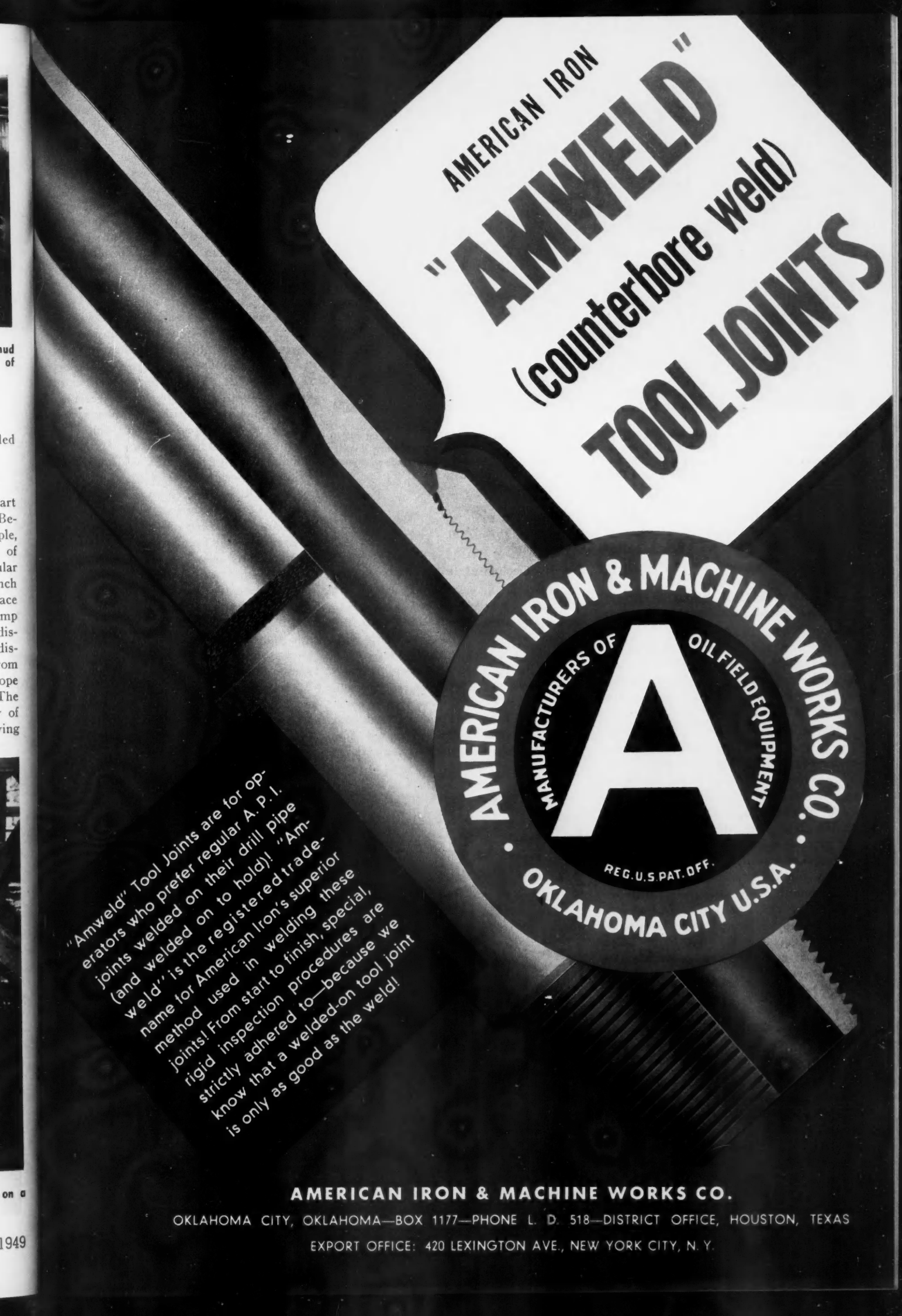
Close control was maintained over the drilling mud. For most of the hole, mud weight was maintained at around 82 pounds per cubic foot. Mud viscosity was held to approximately 72 seconds API. To a depth of about 9000 feet, regular clay-base mud was used, but from there on, a 15 percent oil-base jel fluid was continually fed into the mud stream. Frequent tests were made of the mud, and at various times, certain additives, including bentonite, sodium tetraphosphate and quebracho were added to maintain the desired conditions.

Wire Rope Record

Wire rope, especially in the lower part of the hole, was given close attention. Between 14,985 and 18,623 feet, for example, four new 3200-foot (average) spools of line were placed in service. Regular lay, 6 x 9 improved plow steel 1¼-inch rope was used throughout. From surface down to 16,023 feet, rope having hemp center was used, but this type was discarded at that depth when it was discovered that the line had stranded. From there on IWRC (independent wire rope center) type of rope was used. The practice established by the company of frequently pulling off and removing



Underfloor view of blowout preventer assembly. The two 13⅜-inch preventers were set on a 13⅜-inch by 9⅝-inch casing head.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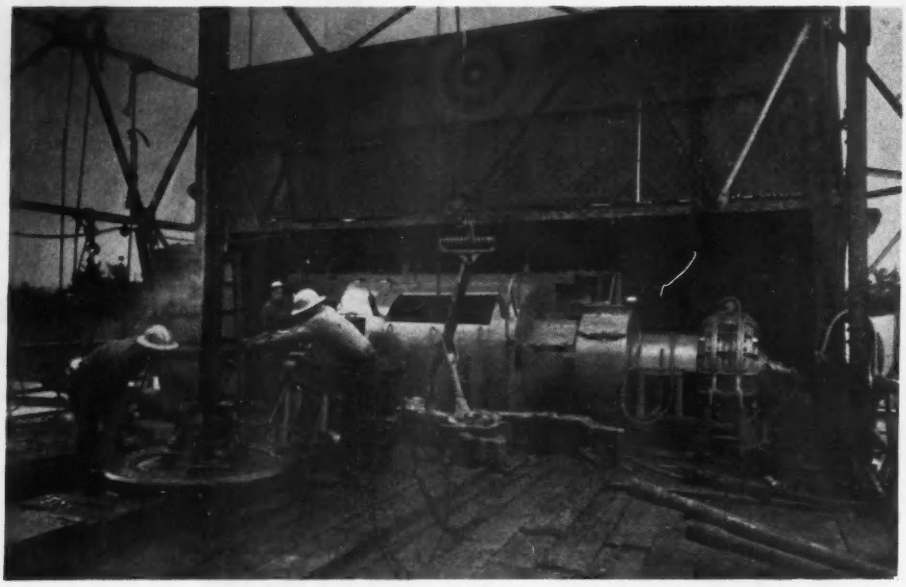


The main drawworks, first put into service in March, 1940, has as its principal feature an extra large drum grooved for 1¼-inch line. It has air-operated second speed clutch and 40-inch double hydromatic brake. It is driven by a 15 x 16, twin drilling engine operating on 500 pounds of steam. Power slips were used throughout the drilling operations.

work rope was rigidly adhered to during the drilling of this well. At a depth of 15,000 feet, the line was being pulled over every third round trip, but as drilling progressed, the frequency was increased to every trip. About 25 feet of rope was cut off and discarded in each such instance.

Based on the accepted methods of computing wire rope service, the several spools referred to above yielded, in the order of increasing depth, the service records shown in Table 1.

The actual service obtained from these lines was of course considerably greater than that reflected in the above ton-miles figures which are based on round trips alone. Such extra services as fishing jobs, running casing, etc. are not included. Nor does this service include the practice maintained by the company of frequently lifting the drill string off bottom for a distance of about 50 feet, or the length of the kelly, while drilling. Lifting the bit off bottom while rotating, to assure the hole being open above the bit, was done every half-hour while drilling at moderate depths, but for the last several thousand feet, it was done every 15 minutes. Cost of the wire rope used on this well was estimated to be in the range of 17 to 23 cents per foot per ton mile of service.

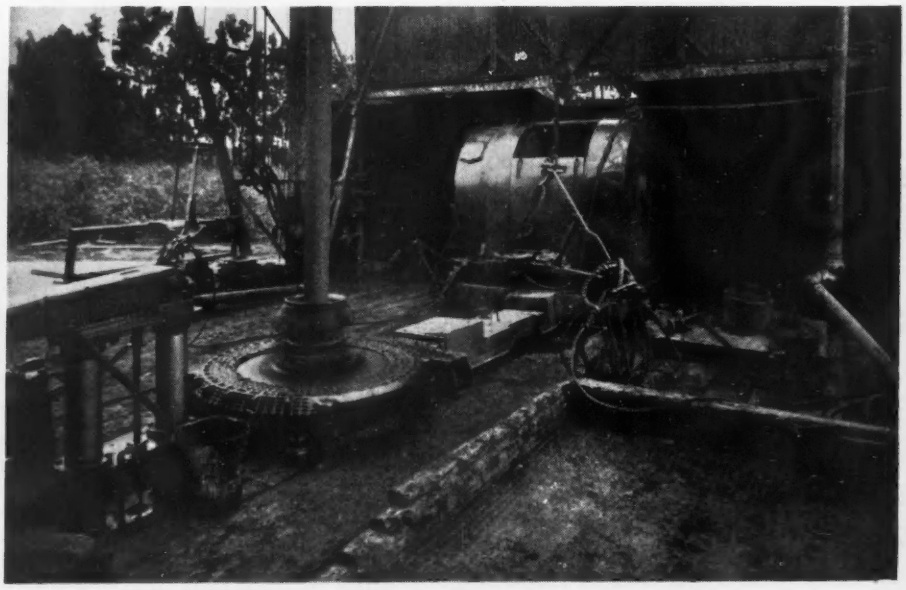
Geological Information

Outside of the several intervals in the well where loose, unconsolidated sands were encountered, and which were the primary cause of the few stuck pipe fishing jobs, a very clean hole was maintained. Fairly steep dips were encountered down to 12,000 feet, while from there to bottom they were quite gentle. No gas pockets were encountered, and the formations drilled presented few problems. After drilling through sands and shales of Recent and Pleistocene age, the bit topped the Repetto of Pliocene age at 15,520 feet. At total depth, it is believed that the well was at or near the top of the Miocene. From near the surface to 1900 feet, a fresh water zone was penetrated, the fluid content of this zone changing gradually to salt water from there to 2600 feet. From 2620 to 5750 feet, the formations were predominantly shale, and from there to bottom the beds penetrated were alternating sandstones, siltstones and shales, with sand formations approximating 75 percent of the total.

The company has gained considerable experience in deep hole drilling in recent years, and by diligent application of information and lessons learned on previous jobs, the drilling to greater and greater depths has not revealed excessive or insurmountable drilling problems.

In care of the project were John C. Cody, vice president in charge of production, Pacific Division; Carl L. Corely, drilling superintendent, California District; L. R. Rogers, chief petroleum engineer; G. Y. Wheatley, resident geologist; and Mel Uffen, drilling foreman.

Credit for the excellent drilling record made on this deep hole, bearing in mind the fact that a nine-year old rig was utilized, and that special or extra-heavy equipment was not used throughout, rightly goes to the personnel on the job and the high degree of cooperation between management, engineers and personnel making up the field crews. Maintenance of equipment to a high degree of efficiency and careful attention to every detail during drilling operations again have proved their worth in the successful drilling of deep wells.



The 20½-inch oil bath lubricated rotary table was shaft driven by the standby drawworks 12 x 12 steam engine, the latter situated across the floor from the main drawworks. Engine throttle and reverse of the standby unit were operated by hydraulic remote control. This standby unit served as storage for new drilling line, the latter being fed into the system as worn line was pulled over and removed periodically.

Record Broken Again

The depth record established by Superior's Limoneira 1 has been broken by the same company's Pacific Creek 1 in southwestern Wyoming. For late information on the latter wildcat, see Page 78 of this issue.

*At 18,734 feet,**

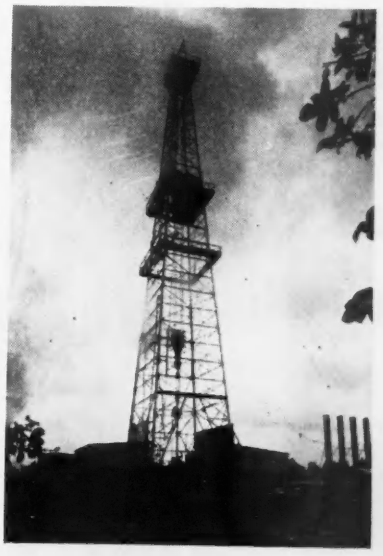
on The Superior Oil Company

world's record depth well,

Schlumberger made an electrical

log in 3½ hours hole time.

*** Schlumberger made two runs below 18,000' on The Superior Oil Company's Limoneira #1, the new world's record depth well. The first run was made at 18,110 feet and the second on March 13, 1949, at 18,734 feet. Both operations were carried out successfully as routine runs with regular Schlumberger surveying equipment and with a minimum of rig time. Only 3½ hours surveying time was required for each run. Performance of Schlumberger equipment on this new world's record well is proof again that Schlumberger is ready now for your 20,000 foot, or deeper, wells.**



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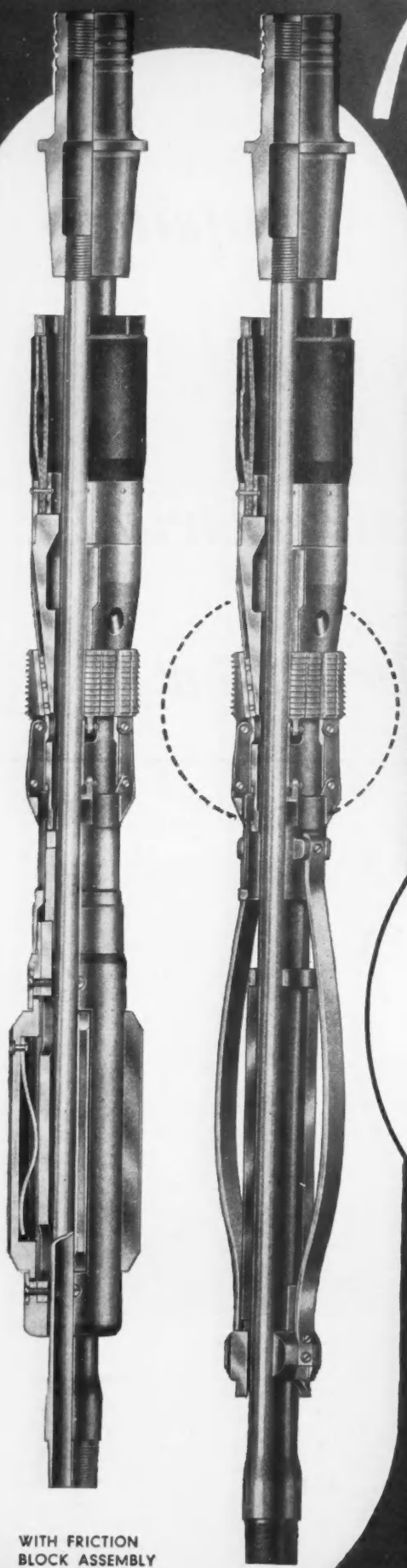
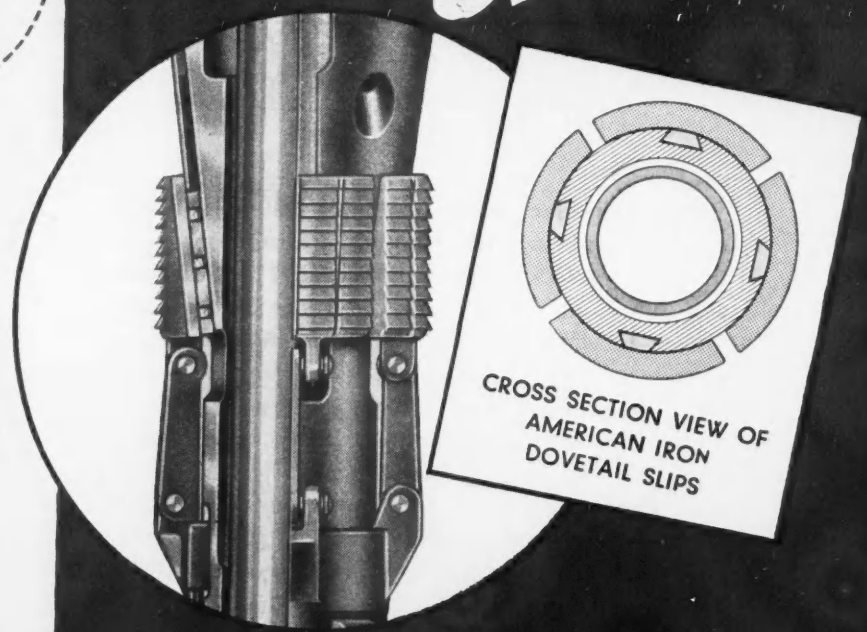


WITH FRICTION BLOCK ASSEMBLY



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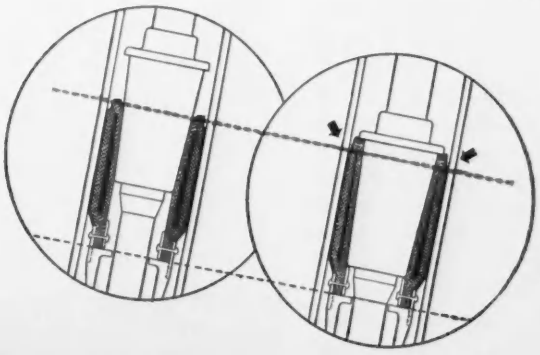

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Increasing Life of

Rotary Drilling Lines

By L. C. TORELL

Wire Rope Engineer, Bethlehem Steel Company

THE drilling of record depth oil wells with rotary tools has directed management's attention to rotary drilling line costs. Several years ago, in an extensive survey based on national averages (local conditions resulted in wide variations), the WORLD OIL found that in drilling to the 7000-8000 foot level one foot of rotary line was consumed for each 25 to 35 feet of hole drilled. This was probably 1⅛-inch diameter line, either with a fiber core or an independent wire rope core.

The drilling of several of the record-depth wells during the past several years consumed rotary lines at a total rate of one foot of line for slightly less than each two feet of hole, with a rope diameter of 1¼ inches. On a comparative basis, at today's prices, the rope cost per foot of hole in the first case would be about 2 cents, in the latter case 37 cents. It therefore becomes evident that rope saving measures consistent with safety are an economic "must." An all too common attitude is found with those who feel that since wire rope cost is but a small fraction of the total cost of a well, conservation measures are unimportant. Much rope is accordingly wasted through thoughtlessness and unwitting abuse, and even more through lack of knowledge about the condition of the partly worn sections.

Oil well drilling machinery, compared with that of other extensive rope-using industries, is under-roped, because it must be mobile; hence as small and light in weight as possible. If and when it becomes economically practical to build and transport larger and heavier equipment which will give the rope a chance to operate under more favorable conditions, unit rope costs can be very sharply reduced. However, this article will be confined to the discussion of existing equipment and practices, and will take up one important measure whereby saving of rope may be attained. We also have in mind the extremely wide variations in rope handling practices and the present lack of knowledge on which they should be intelligently based.

A rotary line is invariably discarded because of wear or damage, or both, to a comparatively small proportion of its total length. This wear is usually worst at the drum flanges where the rope is squeezed up to the next succeeding layer and at the cross-over sections in winding across the drum. It is now almost universal practice to distribute the effects of those wear concentrations by cutting off a section of the rope at the drum fastening and pulling through from the reserve reel. This, of course, is most sensible since a much greater portion of the potentially usable rope life in a given length is thus utilized.

Insuring Safety

Generally the decision as to when to cut off and how much to pull through is left to the judgment of the driller or tool pusher who also is held responsible for safety and preservation of the well. As their rope experience is usually practical and based on field observations, the great majority of them tend to play safe by making very sure that cuts are made long enough and sufficiently frequent to insure safety. This precautionary attitude is perhaps in many cases justified and is evidenced by the extreme rarity of fishing jobs resulting from rope failures.

Less common is the establishment of a fixed set of rules which require cutoffs of varying lengths depending on the number of round trips, the length of time in service and the range of depths.

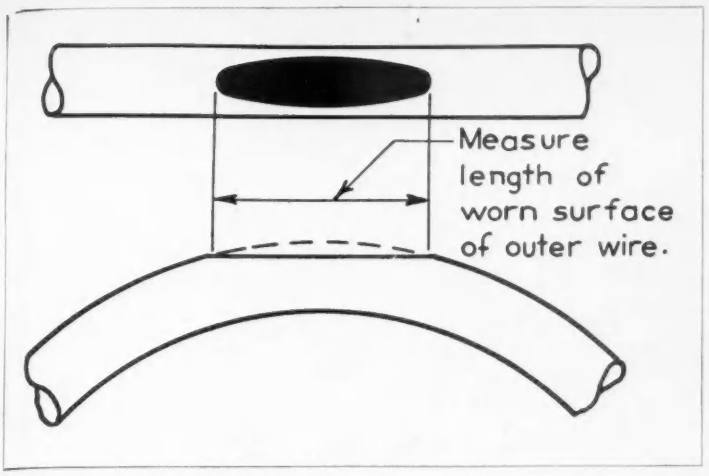
Both methods may easily tend to be wasteful, the first because individual judgment varies widely and is usually conservative, and the second because such fixed standards are necessarily based on average worst conditions, with ample margin of safety, and do not permit greater utilization of available rope life under average or better conditions. How individual judgment may vary is illustrated by the factual case of two identical rigs drilling in the same formation one-half mile apart. The driller on one rig cut and pulled through every three round trips; the other every six. The first wasted rope; the second may have done so.

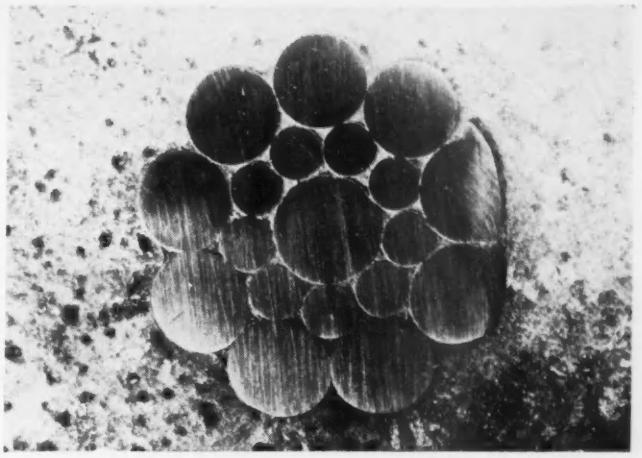
CAUSES OF wire rope wear in rotary service are evaluated with a discussion of methods for estimating residual life without need for reference to charts or tables based on measurement of abraded ovals of contacting wires. The establishment of a central clearing house for rope failure data is suggested, and examples of the type of photographs required are given.

The rope makers and the drillers jointly share responsibility for this wastage. No practical bases have been established for guiding the average field man in determining frequency and length of cuts under the inevitably variable digging conditions in different localities. Such bases can only be established through cooperative effort.

Conventional methods of estimating remaining strength in wire rope do not give thoroughly reliable information when applied to rotary drilling lines. An example is the method outlined on our company's elevator rope remaining strength calculator which is quite accurate when applied to elevator ropes. Where actual outside or crown-wire wear is the main contributing cause to decreased rope life, such as in elevator ropes or in a well designed mine-shaft hoist rope, the remaining strength in a used rope may be computed with reasonable accuracy on the basis of the reduction in cross-sectional area of the strands in the section of the rope showing the greatest amount of outside wire wear. This can be quite accurately determined by measuring the length of the worn oval on the outside wires and reading remaining strength from charts prepared for this purpose. (See Figure 1.)

In a rotary drilling line, however, the problem is not so simple. The visible effects of loss of metal due to crown-wire wear are obscured or even lost through the effects of cold work and flow in the outside wires of a well built





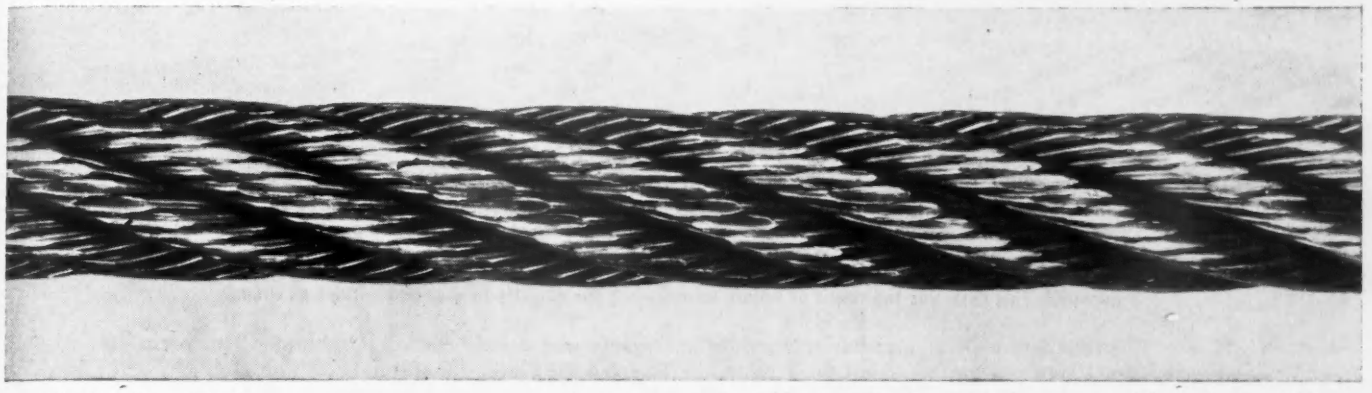


FIGURE 1 (Top left). Measuring the oval area of a worn wire on a strand to enable remaining strength to be determined from chart or table.
FIGURE 2 (Below). Cold work and flow of metal in the outside wires of this rotary line tend to fill the gaps between wires, and to obscure the damaging effect of wear at the areas where the wires contact the sheaves.
FIGURE 3 (Top right). Peening of the outer wires in this strand appears as wear of the contacting surfaces, whereas in fact the metal is largely displaced and weight of the deformed wire is close to that of the original cross-section.

rotary line. (See Figure 2.) High hoisting speeds, small-diameter drums which necessitate multiple-layer winding, and high radial pressures on the rope cause concentration of what appears to be wear through point-to-point contact accentuated at points such as where the line climbs up from one layer on the drum to the next, and at cross-over points when the ongoing rope climbs out of the groove twice with each turn of the drum. The high pressures caused by wedging, and aggravated by the high speed of the drum, produce a peening effect resulting in a cold flow of the metal in the outer wires of the ropes which resembles wear but is mostly displacement. (See Figure 3.) This is further accentuated by the slip of the rope between wraps which occurs whenever the blocks are unloaded as in upward travel, hence spooling is not tight. The slip occurs when the load is picked up and lowered on the downward trip. Consequently, the outer wires may be flattened to an extent where as little as 84 percent (or sometimes considerably less) of the original round diameter is retained (see Figure 4), with actually over 96 percent of the original cross-sectional area and breaking strength remaining. This applies to the outer wires only, the inner wires, of course, remaining undisturbed. Thus the over-all breaking strength of the rope illustrated in Figures 2, 3 and 4 is probably not reduced nearly as much as the physical outside appearance would indicate. Any estimate of remaining strength based on measurement of what appears to be a decrease in the diameter of the outer wires may obviously be grossly misleading. However, the use of wire which will withstand this great amount of cold work and peening without excessive effect of work hardening to the point of bending fatigue failure is a requisite in a well-built rotary line.

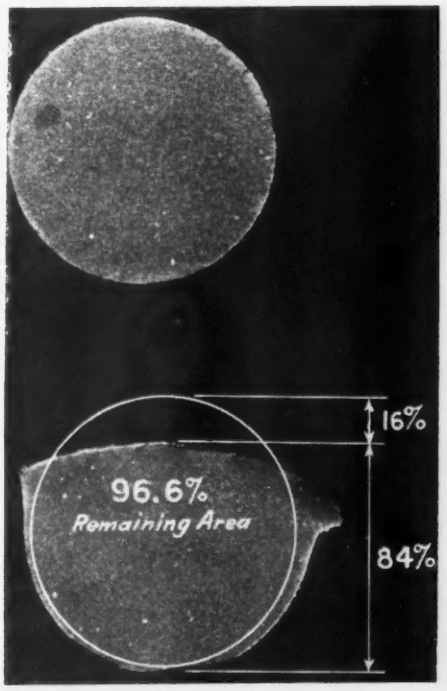


FIGURE 4. Although the diameter of this wire, measured from the bottom upwards, appears greatly reduced by effects of service, the actual areal extent is not reduced nearly as much as the apparent 16 percent reduction would indicate.

It is doubtful that any method for determining remaining strength involving the use of measurements and graphs would find wide acceptance except possibly with those companies who have trained engineers on the job most of the time. With this in mind a procedure is proposed which is believed to offer a reasonable solution to the problem where circumstances are normally variable. The program to be outlined calls for cooperation between drillers and wire rope producers, and like most worthwhile undertakings, it can be achieved only through the expenditure of time, effort, and some money.

Briefly stated, Bethlehem Steel Company's mill laboratory at the Williamsport, Penn., wire rope plant will within the limits of their facilities cooperate with any drilling operator who will submit to them for testing a series of rotary line specimens, regardless of make. From each positively identified line the laboratory will need an unused end at least six feet long, to be used in determining the

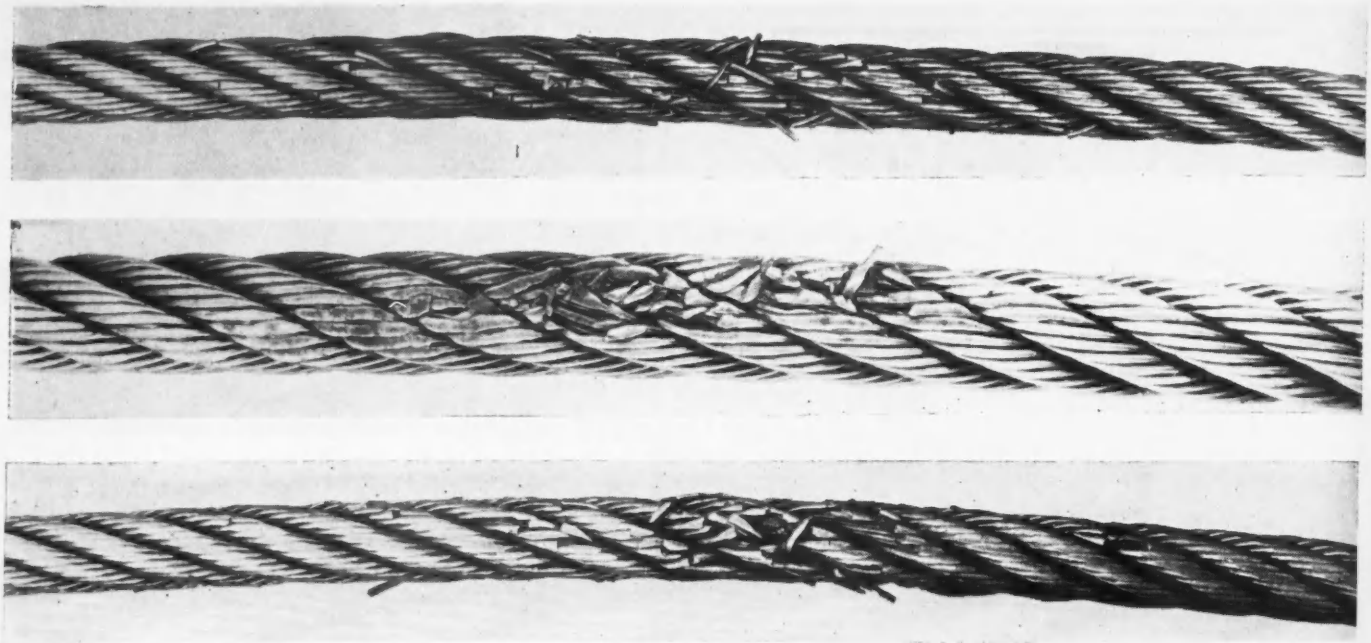


FIGURE 5 (Top). 1⅛-inch, 6 x 19 Seale, regular lay, IWRC. Reason for failure: Cross over position on top layer of 24-inch drum of portable drawworks. This case was the result of failure to make regular cut-offs to change cross-over positions on drum.
FIGURE 6 (Center). 1⅛-inch, 6 x 19 Seale, regular lay, IWRC, Formset. Reason for failure: Drum abuse, showing early stage of cross-over condition.
FIGURE 7 (Bottom). 1⅛-inch, 6 x 19 Seale, regular lay, IWRC, Formset. Reason for failure: Cross-over position on top layer of 24-inch drum of portable drawworks. This case was the result of failure to make regular cut-offs to change positions on drums.

actual breaking strength of the line. Catalog breaking strength will not do in this case, since actual unused strength will usually vary slightly from values, depending on the manufacturer.

From the same line the user should also submit several eight to ten-foot sections, each of which should represent the worst condition which justified that particular cutoff. Some rope will be wasted in taking such a sample, as the point of maximum wear will be at some distance from the drum-end fastening. A record of the number of round trips made between cuts and the size and weight of the drill pipe should also be submitted, with any other data pertinent to the case.

At the laboratory photographs will be taken of all specimens as received. The specimens will then be cleaned and photographed again. Finally the section will be broken to determine the percentage of strength remaining compared with that of the unused end. The inside of the rope will also be examined.

The testing program should be carried out with both fiber core and IWRC lines, because it is possible that the proportional loss in strength between the new and the used specimens may differ with the type of core.

The outlined procedure will make it possible to build up a real library of actual photographs presenting the surface appearance of a large number of worn drilling lines, and provide data on the actual strength of these lines in relation to their unused strength. Drilling operators will thus eventually have at their disposal a reasonably accurate visual representation of safe and unsafe conditions that may be used as a guide in determining when to cut-off and pull-through.

All the constructively useful photographs and data accumulated in such a testing program should be published or otherwise made available to the field.

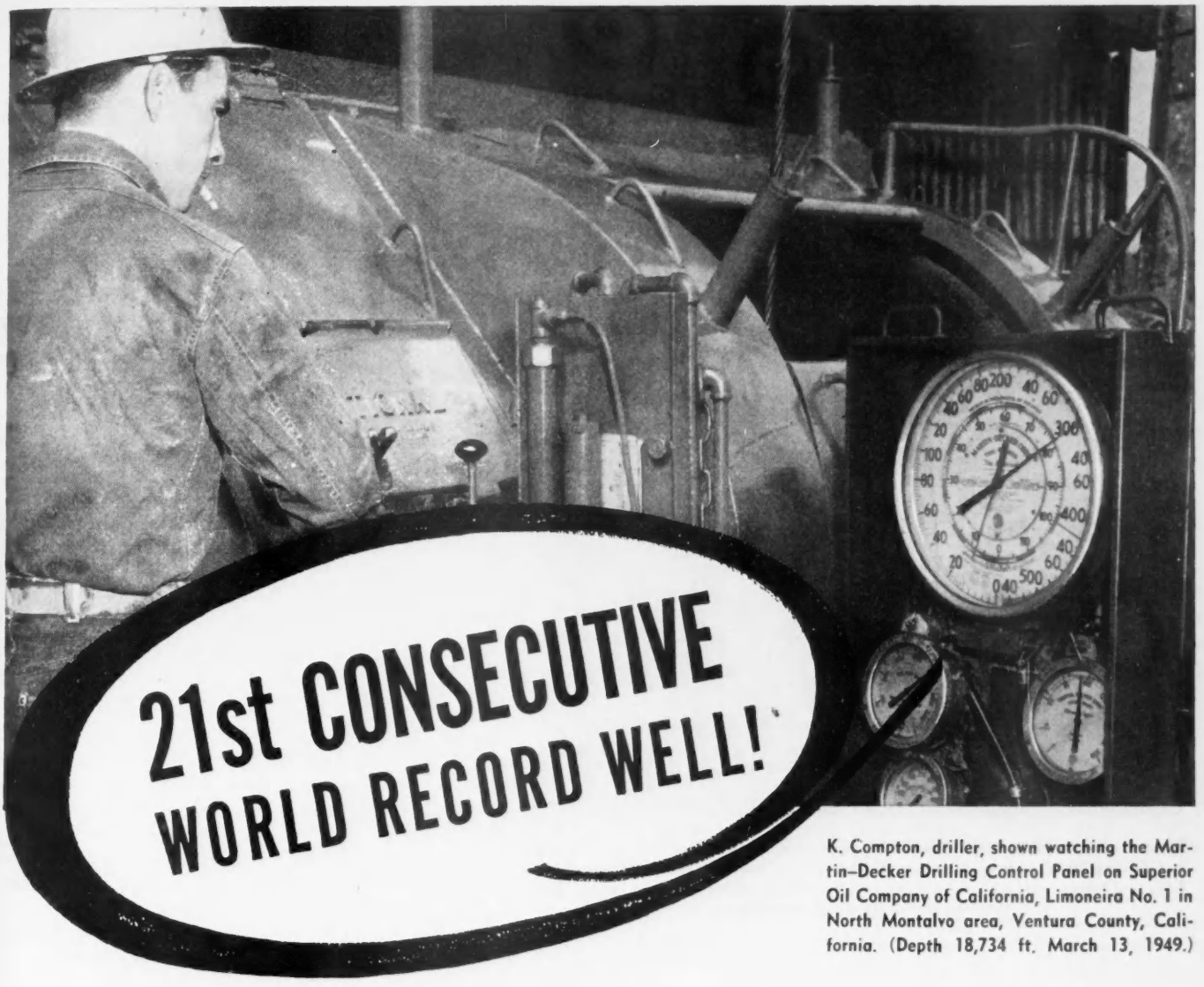
Obviously, no blanket answer can be given that will cover all conditions in all fields. For cases involving severe corrosion or unusual service conditions special precautions may be called for.

The simplicity of the proposed method will undoubtedly appeal to the men in the field, who are inclined to shy away from elaborate charts and tables or similar methods of estimating remaining rope strength, which to them look like, and often really are, jobs for an engineer. A simple visual presentation that may be used directly at the rig should have every chance of broad and useful acceptance.

Figures 5, 6, and 7 are photographs of rotary lines which illustrate various types of damage caused by too great delay in moving the maximum wear positions of the line. Up to this time specimens showing such conditions are the only ones our mill laboratory receives — usually because the user feels that the line is defective. Also shown are the recommended cutting practices for both fiber core and IWRC rotary lines as used by one drilling company. We consider this better than no guide at all, but feel that greatest rope economy on present drilling rigs, consistent with safety, will come from a procedure which will permit the field men to vary the frequency and length of cuts as drilling conditions vary.

About the Author

L. C. TORELL was born in Cambridge, Minn., served in the Navy during World War I, and entered the University of Minnesota to study civil engineering. In 1923 he was employed as field engineer with Toltz, King & Day, St. Paul, and remained until 1925, when he became associated with Fegles Construction Company, Minneapolis. As contractor engineer he supervised the construction of grain elevators, locks, dams and similar projects in the U. S. and Canada. In 1936 he accepted a position with Williamsport Wire Rope Company and when this concern was acquired by Bethlehem Steel Company in 1937, he remained with the new owners as wire rope engineer. Since 1938 he has made his headquarters at the company's home office in Bethlehem, Penn.



21st CONSECUTIVE WORLD RECORD WELL!

K. Compton, driller, shown watching the Martin–Decker Drilling Control Panel on Superior Oil Company of California, Limoneira No. 1 in North Montalvo area, Ventura County, California. (Depth 18,734 ft. March 13, 1949.)

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A Well Completion Technique for North Louisiana

By J. M. REYNOLDS
President, The Reynolds Specialty Company, Inc., Shreveport

Typical surface equipment required in operating the combination sand pump and drilling bit. Trailer in foreground is used to transport the tool to the location. Rods and tubing were pulled from the well by the portable unit shown, and it also operated the cutting and bailing tool.

A RELATIVELY new technique in completing shallow oil wells of low producing formation pressure has reduced drilling costs in several North Louisiana fields. This method of completion utilizes the inherent advantages of cable tool operations in reservoirs of this type, yet it does not require that a drilling rig remain at the location for the actual completion. Economies have been effected and formations are left with little contamination.

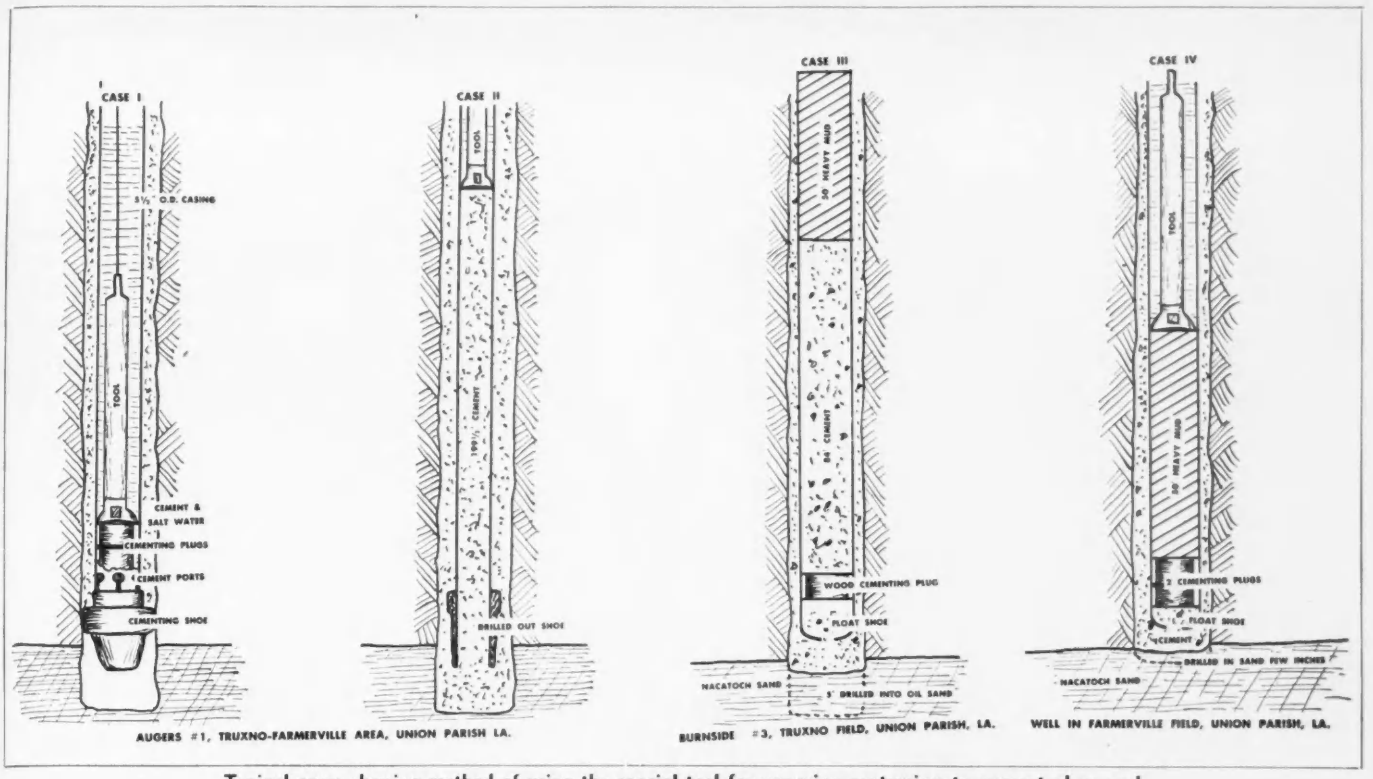
ADVANTAGES of cable tool completions over rotary drilling methods have long been recognized in areas and individual cases where this type operation is applicable. These advantages stem from two primary considerations, (1) cost and (2) damage to producing formations of relatively low pressure. Because of the small hydrostatic head required in cable tool drilling, the danger of contaminating the sand face with water and mud to such an extent that production will be impaired is not as potential a hazard as in the case of rotary drilling where a full column of fluid must exist in the hole.

These two distinct advantages have accounted for the drilling in of more than one-third of the wells drilled in this country during 1948. It is interesting to note that most of these wells were drilled in the low-pressure, shallow-depth areas of Illinois, Pennsylvania, Kansas, North Texas, Oklahoma and North Louisiana. It is common practice in many of these areas to drill to the top of the producing formation and cement casing with a medium-depth rotary rig, then move in a cable tool rig during the waiting-on-cement time for the completion.

The cable tool completion idea has been carried several steps further in a new technique used successfuly in North Louisiana since March, 1948. The principal of chiseling or chopping up the sand face and formation is utilized, with the additional advantage of bringing up samples of the formation each time the tool is brought to the surface. When drilling quite close to the producing formation, and if it is desired to drill into the pay zone only a few inches, samples taken at short intervals will reveal exactly when the oil bearing stratum has been tapped. Knowing exactly where the top of the producing formation lies, the operator can then drill into the pay zone the desired number of feet or inches as the sand thickness and water-oil contact dictate. It is possible to obtain sufficient indications by proceeding inch by inch so that drilling can be continued or stopped at the most advantageous point.

Equipment employed in drilling into the oil-bearing sand is also used to drill out bridging plugs, cementing plugs, columns of hardened cement and casing shoes. These operations are accomplished with a minimum of surface equipment. The usual procedure in completing wells in the low pressure fields of North Louisiana is to cement the casing in the cap rock above the pay horizon. After the cement has been placed in the well and a good cement job obtained, the drilling tools, whether rotary or cable tools, can be moved off during the cement waiting time. The only necessary surface equipment required in using this new completion technique is a portable winch and boom or A-frame mast.

Completions of this type have been successful and quite economical in the Oil City, Farmerville and Truxno fields of Union Parish, as well as farther south near Bull Bayou. Wells completed to



Typical cases showing method of using the special tool for removing contaminants, cement plugs and heavy mud prior to drilling specified depths into producing sands.

date range in depth from 900 to 2200 feet. For the most cases, production comes from the Nacatoch sandstone. Sub-surface equipment used in drilling up the formation and bailing the cuttings from the hole as the operation proceeds is a combination cable tool drilling bit and sand pump. It is approximately 22 feet in over-all length, and is made in several outside diameter sizes depending upon the casing size or diameter of the hole in which it is to be used. The tool consists primarily of a long, heavy, cylindrical body in which a plunger reciprocates. The lower section of the tool includes a 17-foot loading chamber, an outgauge chisel or cutting bit, a flapper valve and a side door opening. The outgauge feature of the bit permits a larger hole to be drilled than the O.D. of the tool body, thereby reducing the sticking hazard. The outgauge chisel also keeps the casing clean and cuts a bore hole into the producing formation of the largest diameter the casing will permit.

In operation, the tool is lowered in the well to bottom. Once bottom is known, the tool is raised a distance of ten feet and allowed to fall freely. Upon striking bottom, be it cement, heavy mud, cementing plugs, casing shoe or the formation itself, a chipping effect results. As the tool body motion is stopped, the inner plunger falls until it meets the dump collar on the bottom. An upward pull of the wire line lifts the plunger about 17 feet, thereby creating a suction on bottom. Aided by whatever hydrostatic head exists, loosened material on bottom is drawn up into the loading chamber through the flapper valve. On the next stroke, the plunger falls through the fluid in the tool and stops when in contact with the extracted material. A traveling valve in the plunger allows the fluid to pass through the plunger tubing as it falls. But on the up-stroke, the fluid is lifted out the top of the tool.

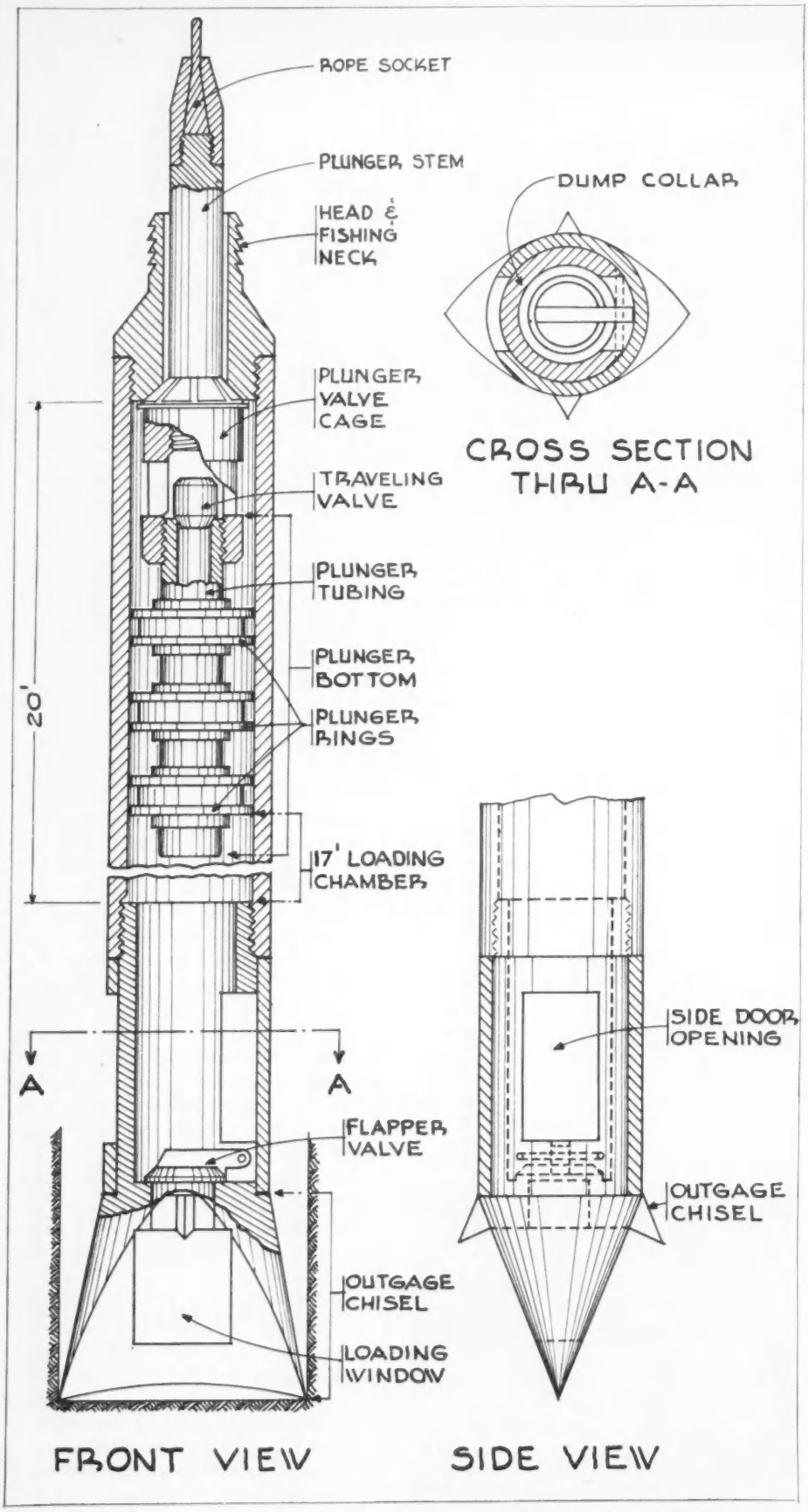
This digging and bailing operation continues until the plunger has very little down travel. The tool is then withdrawn from the hole and dumped. Length of plunger travel can be controlled so that only a small quantity of cuttings can be drawn into the loading chamber if it is desired.

Broken pieces of a bridging plug drilled up and bailed from the well. The side door is shown open with some of the solid pieces in loading chamber. Fluids have been dumped from the tool.

While this tool can be run in the hole with the sand line on either rotary rigs or regular cable tool rigs, it is not necessary that the rig equipment be available for these completion operations. In fact, most of the jobs performed to date have required only a portable wire line hoist and mast or A-frame. Two men are required to operate the tool under the direction of an experienced serviceman. The operator controls the fall and pickup of the tool, while the floor man aids in work near the well head during the drilling operation. The combination sand pump and drilling bit is transported on a specially-designed trailer that can be easily pulled by any passenger automobile.

In many of the wells completed in North Louisiana, the production string is 5½ inches outside diameter. In these cases, a tool is used with an outside body diameter of 3½ inches and an outgauge bottom or bit with a diameter of 4½ inches, leaving about one-fourth inch clearance between either side of the blade and the casing wall.

Type of fluid and height of the fluid column are determined by the operator, since drilling with this particular tool can be accomplished with a minimum of hydrostatic head. If the well has been drilled with a rotary rig, and the hole is filled with mud, it is desirable from a standpoint of protecting the producing formation, once it is tapped, to remove as much of the mud as possible before commencing to drill. If the operator deems it necessary, only 40 or 50 feet of fluid can be left on bottom, with the



Schematic diagram of the combination sand pump and drilling bit employed in well completions in North Louisiana.

remainder bailed out with a dart-type bailer.

With the well cleaned of drilling mud, the tool is lowered to bottom. Once the operator knows where bottom is located, he can proceed. The tool is raised approximately ten feet and then permitted to drop freely. If there is heavy mud which has settled to bottom and which the dart-type bailer had difficulty in removing, the tool will dig into it. When the line is released at the surface and the bit strikes bottom, the plunger falls to its lower position. When the winch operator pulls the line, the plunger travels upward about 17 feet before the tool is raised off bottom. The suction created inside the loading chamber plus the slight hydrostatic head, forces the loosened cuttings into the tool. These cuttings are carried in the tool during the remaining drilling operation. The winch operator is able to determine when the 17-foot loading chamber is filled by measuring the amount of free upward movement of the line before the tool is picked up. When the loading chamber is filled, the tool is brought to the surface and dumped.

A tool of 3½ inches outside diameter and approximately 22 feet in length, weighs about 370 pounds. Experience has shown that a 10-foot drop is an optimum dropping distance for fast drilling into cementing plugs, plastic float shoes, cement, and into the Nacatoch sand.

This manner of simulated cable tool drilling accomplishes two purposes: (1) it chips up material in the bottom of the hole; and (2) it removes the loose pieces by sucking them up into the bore of the tool with every stroke. Subsequent blows are not wasted in part or completely by any cushioning effect of material previously drilled up.

As the cementing plug or plugs and float shoe are drilled up and the operation proceeds through the cap rock, continuing into the actual pay formation, in and out runs are made frequently to obtain samples of the sand. Winch operators are frequently asked to drill just two inches into the Nacatoch sand to get a good formation sample and from it make last minute decisions. This controlled drilling in such a soft sand can be accomplished by lowering the plunger within the tool a distance of one or two feet, and thereby pulling into the loading chamber not more than a few inches of the sand. When the sand has been penetrated several inches, the well is permitted to stand in order to determine how much oil and with what force it is entering the well bore at the bottom. Frequently, a few inches into the oil formation is sufficient to make an excellent producer.

Since this completion technique was first tried in March, 1948, several interesting case histories have been recorded. While not all wells upon which work was performed made good producers, experience has shown that the economics and practical aspects of the technique are sound. In the Truxno-Farmerville area of Union Parish, a 5½-inch casing was

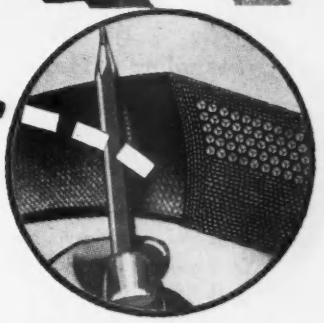
■ CONTINUED ON PAGE 112

Make this Test with ANY V-Belt

You'll See at Once Why the

CONCAVE SIDE---

(U.S. Patent No. 1813698)

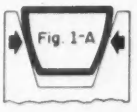


Saves You Money!

Bend any V-Belt and feel the sides change shape. The top of the belt, under tension, *narrows*. The body, under compression, *widens*. The sides of the belt bulge out.

The result, if the belt is built with *straight sides*, is a shape that does not fit the sheave groove—as shown in Figures 1 and 1A, below.

Straight-Sided V-Belt



How Straight-Sided V-Belt Bulges in Sheave-Groove

Clearly, the bulging of the sides will produce excessive wear along the *middle* of the sidewall as indicated by arrows.

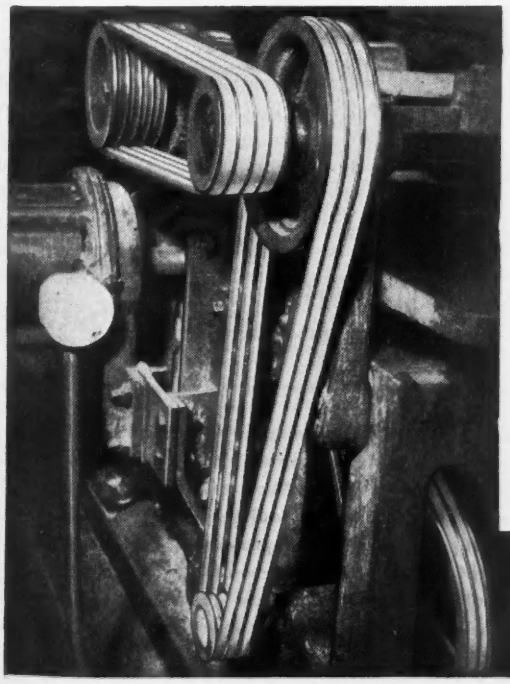
Now, bend a V-belt with the *concave* side—the Gates Vulco Rope.

You get the same shape change but *now* the new shape exactly fits the sheave groove—as shown in Figures 2 and 2A.

Gates Vulco Rope with Concave Side.

No Side Bulge. Precise Fit in Sheave-Groove.

Results? (1) *Uniform* sidewall wear; *longer life!* (2) Full sidewall grip on the pulley. Carries heavier loads and *sudden load increases* without slippage; saves *belts* and also saves *power!*



The Concave Side is *MORE IMPORTANT NOW* Than Ever Before

Because the *sides* of a V-Belt are what actually *drive* the pulley, it is clear that any increased load on the belt means a heavier load that must be transmitted to the pulley *directly* through the belt's sidewalls.

Now that Gates *SPECIALIZED* Research has made available to you SUPER Vulco Ropes—carrying fully 40% higher horsepower ratings—the life-prolonging Concave Side is naturally more important in conserving belt life today than ever before.

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Chemical Treatment of Cement-Contaminated Drilling Muds

By R. W. JONES
Stanolind Oil and Gas Company, Tulsa

DRILLING fluids are complex fluid mixtures consisting essentially of a base liquid, usually water, and various solid constituents that are present in varying amounts and states of division. Properties of drilling fluids which determine their efficiency in performance are state of division of mud solids, viscosity, thixotropy, density, and hydrogen ion concentration.

One of the most important functions of a drilling fluid is its depositing upon the walls of the hole a thin, impervious mud sheath which will prevent intrusion of the drilling fluid into the formation and at the same time prevent caving of the formation into the hole. This wall-building property of a drilling fluid is dependent primarily on its colloidal properties.

In some localities, mud-making bentonitic shales possessing colloidal properties sufficient to meet the requirements of drilling are encountered. In other cases special clays having highly developed colloidal properties must be added to bring the fluid up to the desired quality.

During normal drilling operations the viscosity of the drilling fluid tends to increase because of accumulation of large amounts of total solids, exchange of metallic ions between the clays of the drilling fluids and shales drilled through, loss of deflocculating agents, the presence of flocculating salts in the formations drilled through, and contamination with cement encountered while drilling out cement plugs.[1] Cement contamination is one of the most common mud troubles.

Actual field operations have shown that natural Gulf Coast clay drilling muds which have been subjected to heavy sodium acid pyrophosphate treatments during the course of drilling have a much greater resistance to the adverse effects of cement than untreated natural muds.

This investigation was made to account for the difference in behavior of these muds toward cement and to determine an effective means of treating natural muds for cement contamination.

Materials and Methods

Gulf Coast natural muds, untreated and treated with sodium acid pyrophosphate, El Paso clay slurries, Atlas Unaflo cement, slow setting oil well cement, and 10 percent solutions of both Baker's Analyzed monosodium orthophosphate and Victor Brand C. P. sodium acid pyrophosphate were used during this investigation.

After the addition to the mud of the desired concentrations of cement or treating agents and cement, aliquots suitable for the determination of the changes in mud properties were removed at intervals of 15 minutes, two hours, six hours, and 24 hours.

The viscosity, water loss, and pH measurements were made after 15 minutes stirring on a high speed mixer by standard methods recommended by the API.[2] The viscosities are reported as Stormer viscosities at 600 revolutions per minute and the water loss as cubic centimeters per 30 minutes through Whatman's No. 52 filter paper under pressure of 100 psi.

In pretreating the muds for cement contamination the monosodium orthophosphate was added 15 minutes before the cement and in post-treating the sodium acid pyrophosphate was added one hour after the addition of the cement.

Effects of Cement on Natural Muds

The effects of cement on a Gulf Coast untreated natural mud collected in East Hackberry Field while drilling at 7950 feet in brittle shale on a natural mud which had received sodium acid pyrophosphate treatment prior to its collection from the same well while drilling at 10,937 feet were studied in this investigation.

Figure 1A shows the effects of cement on the water loss of the untreated and treated East Hackberry mud. The water loss of a mud is a measure of its wall building properties and is the filtration rate of a given quantity of mud in cc./30 minutes as determined by means of a filter press using a Whatman No. 52 paper and a differential pressure of 100 psi. The water loss of the untreated natural mud increased over a 24-hour

THE AUTHOR discusses the results of an investigation made of the effects of oil well cement in natural untreated and sodium acid pyrophosphate treated natural clay drilling muds. The greater resistance to the adverse effects of cement of natural clay drilling muds which have been subjected to heavy sodium acid pyrophosphate treatments during the course of drilling is due to the presence of monosodium orthophosphate formed by reversion of the sodium acid pyrophosphate. Laboratory investigations show monosodium orthophosphate to be an effective pretreating agent for the prevention of cement contamination in clay drilling muds.

test period from 16 cc./30 minutes to 35 cc. upon contamination with 1.0 lb./bbl. cement and increased to 69 cc. over the same period of time upon contamination with 5.0 lb./bbl. cement. Whereas the water loss of the East Hackberry mud which had received heavy sodium acid pyrophosphate treatment during the course of drilling remained unchanged over a 24-hour period upon contamination with as much as 5.0 lb./bbl. cement.

It is now recognized that the individual particles of clays such as the natural East Hackberry mud consists of thin plate-like sheets stacked upon each other in layers. On one of the flat surfaces of each individual leaflet are attaching cations such as sodium, calcium, etc., and the opposite surface is slightly negative with respect to the surface bearing the cations.

These clays ionize to give positive ions and negative bentonite ion. According to Jenny and Reitemeier[3] the relative degree of ionization of the more common clays decreases in the order of Li, Na, K, NH_4, Mg, Ca, Sr, Ba, and H. Thus a clay that is predominantly sodium bentonite will have a relatively higher negative particle charge than a calcium bentonite because of its higher degree of ionization. The greater degree of ionization and greater positive ion hydration of sodium bentonite cause such clays to swell more and to absorb a higher percentage of water than calcium bentonites. The higher absorption of water by a sodium bentonite clay inactivates a portion of the water in which the clay is suspended, thereby producing a mud with a relatively low fluid loss.

When such a mud is contaminated with cement, the calcium ions from the calcium hydroxide in the cement reduce the degree of hydration and repress the ionization. This reduces the forces stabilizing the suspension and causes aggregations of the clay particles which, along with the decreased hydration, accounts for the large increase in water loss of the natural untreated mud.

Prior to the collection of the mud from a depth of 10,937 feet, sodium acid pyrophosphate had been used in the mud system as a deflocculating agent to control the viscosity of the mud. When added to a drilling mud, sodium acid pyrophosphate appears to hydrolyze to the ortho form:

$$Na_2H_2P_2O_7 + H_2O \rightarrow 2NaH_2PO_4$$

This effect is most pronounced in deep wells where the bottom hole temperature is high. Therefore, it is necessary during the actual drilling constantly to add relatively large quantities of sodium acid pyrophosphate to maintain the viscosity within satisfactory limits.

Even though a considerable volume of mud may be lost or discarded during the drilling of a well, the mud retained for drilling will contain a relatively high concentration of the residual orthophosphate. Chemical analysis of the filtrate from the treated East Hackberry mud showed a concentration of 0.85 lb./bbl. monosodium orthophosphate.

This mud showed practically no increase in water loss upon contamination with as much as 5.0 lb./bbl. cement due to the removal of the troublesome calcium ions in the form of insoluble calcium phosphate as a result of their reaction with monosodium orthophosphate, as shown in the equation:

$$2NaH_2PO_4 + 3Ca(OH)_2 \rightarrow Ca_3(PO_4)_2 + 2NaOH + 4H_2O$$

Figure 1B shows the effects of cement on the pH of untreated and treated East Hackberry mud. The sharp increase in the pH of the untreated mud

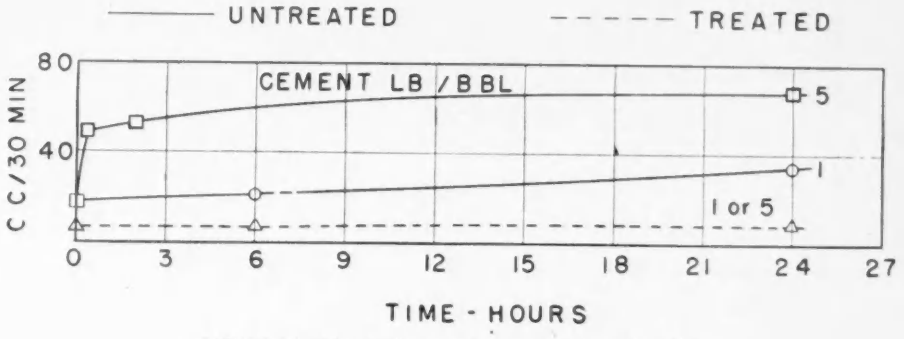


FIGURE 1A. Effects of cement on water loss of muds.

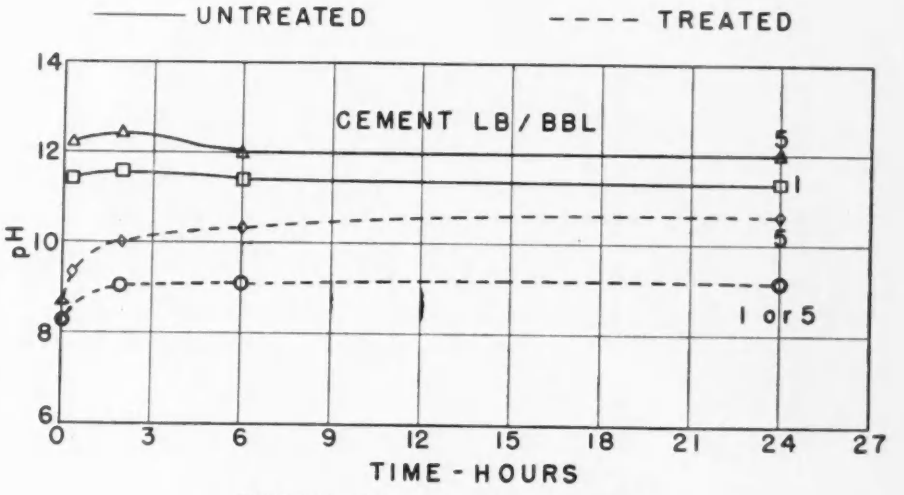
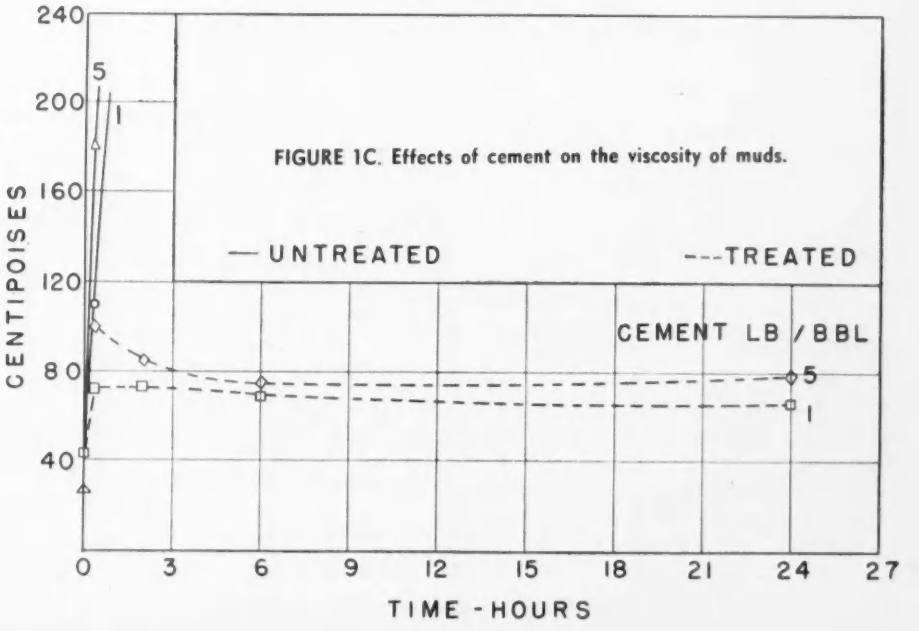


FIGURE 1B. Effects of cement on pH of muds.



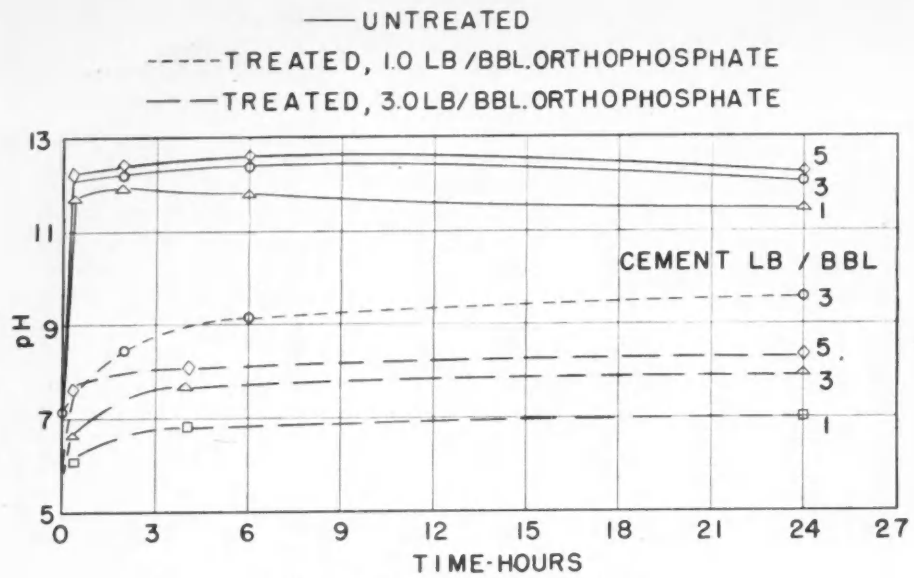


FIGURE 2A. Effects of cement on pH of muds.

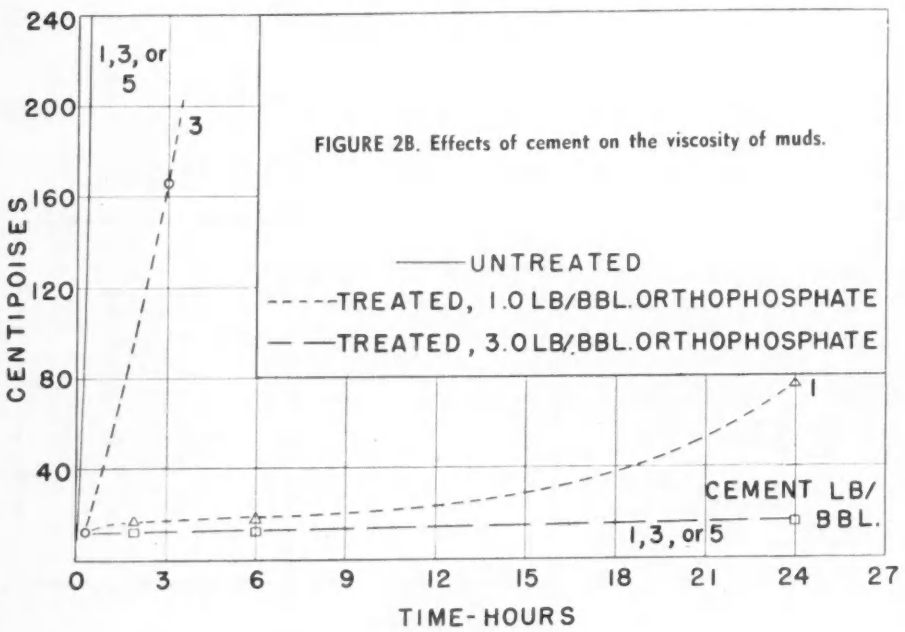


FIGURE 2B. Effects of cement on the viscosity of muds.

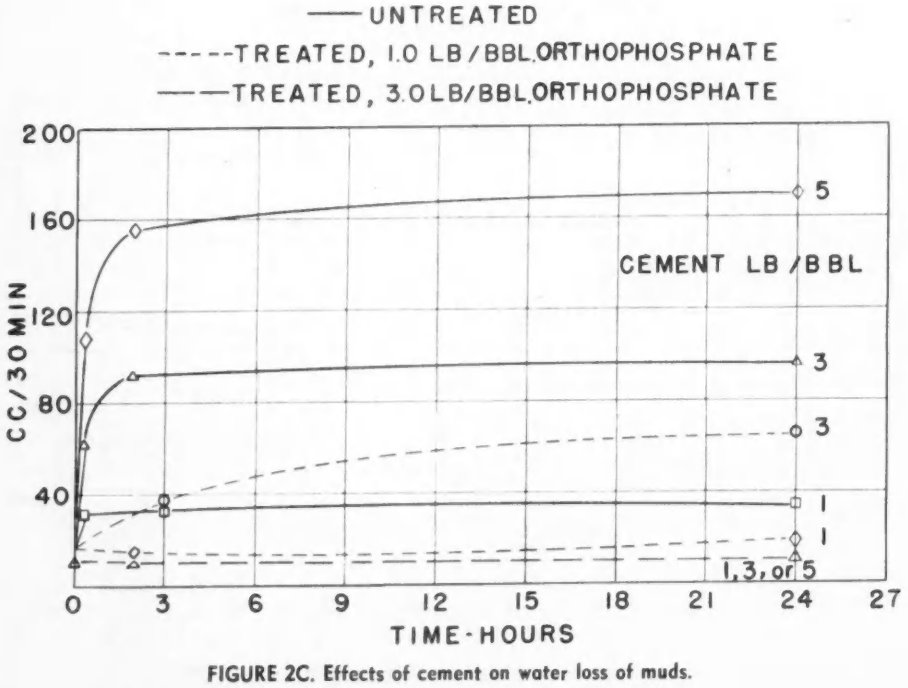


FIGURE 2C. Effects of cement on water loss of muds.

upon contamination with cement is due to the release of hydroxyl ions from the calcium hydroxide present in the cement. The lower pH encountered upon contamination of the mud which had been subjected to heavy sodium acid pyrophosphate treatments is due to the buffering action of the residual monosodium orthophosphate in the mud. Hydroxyl ions are removed as a result of their reaction with monosodium orthophosphate to form disodium orthophosphate, as shown below:

$$NaH_2PO_4 + NaOH \rightarrow Na_2HPO_4 + H_2O$$

Figure 1C shows the effects of cement on the viscosity of treated and untreated East Hackberry mud. The viscosities of both the untreated and treated muds were greatly increased by cement contamination; however, the viscosity change of the mud which had been subjected to heavy sodium acid pyrophosphate treatment during drilling was much less than that of the untreated mud.

The viscosity of clay suspensions is dependent upon the hydration of the clay particles and upon the repulsive forces between the individual clay particles. Any added impurity such as calcium ions from cement which tends to reduce the degree of hydration or particle charge and reduces the repulsive forces between the individual clay particles causes increased friction between the clay particles and aggregation of the particles both of which result in increased viscosity of the mud. Since the residual orthophosphate in the treated mud tends to remove the calcium ions and prevent large pH increases, the resulting viscosity increase upon cement contamination is much less than in the untreated mud.

Treatment for Cement Contamination

Chaney[4] states that the following results must be accomplished in treating cement contamination mud.

1. Remove the calcium ions as an insoluble precipitate.
2. Reduce the pH to approximately the value before contamination.
3. Redisperse the clay aggregates as much as possible.
4. Replace with fresh clay any colloidal material that cannot be restored to its original condition.

Among the chemicals that have been used in treating cement contaminated muds are sodium bicarbonate, quebracho extract, mixtures of sodium bicarbonate and quebracho extract, monsodium orthophosphate, mixtures of monosodium orthophosphate and a complex phosphate, and sodium acid pyrophosphate.

When it is known in advance that contamination with cement will take place, it is desirable to pretreat the mud

Take His Advice About CLIPS

Improper use of wire-rope clips can be costly and dangerous. There's a right way and a wrong way to attach clips, and if you aren't sure which is which, the Bethlehem field engineer will be glad to show you.

First, though, he suggests you study the three drawings shown here. The main illustration shows the right way—the safest way. Note that the live end of the wire rope is not crushed or distorted, because the clamping pressure is distributed over the full base of the clip. The dead end is held by the U-bolts; thus the concentrated pressures are applied at the points of least stress.

The top picture shows how clips should *not* be attached—with the crushing pressures of the U-bolts applied to the live end of the rope, at points of greatest stress. Distortion and crushing at these points will hasten wire-rope failure and reduce the strength of the complete attachment.

The other small picture shows an all-too-frequent compromise—also wrong. Here, two of the clips are properly attached; the center one improperly. Crushing of the live end by one U-bolt creates a point of weakness. This arrangement is little if any better than that described in the paragraph above.

Just as a double-check, ask a Bethlehem engineer to look over your set-up. He'll quickly spot any clips that are not attached properly. Also, while he's there, he'll be glad to help you with any other wire-rope problems. Call for his services—they're free, and they're always available.

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with as much of the chemical as can be added without destroying the mud properties. Since it has been shown that monosodium orthophosphate tends to counteract the adverse effects of cement an investigation was made to determine the amount of monosodium orthophosphate required to maintain the original viscosity, water loss, and pH of a natural mud after cement contamination.

Figure 2A shows the effects of cement on the pH of an untreated and monosodium orthophosphate treated Gulf Coast natural mud from Lucky Field. The addition of 3.0 lb./bbl. monosodium orthophosphate reduced the pH of the mud from 8.25 to 5.85. This treatment was effective in maintaining a pH of from 7 to 8.25 over a 24-hour period upon contamination with from 1.0 to 5.0 lb./bbl. cement, whereas the pH of the untreated mud ranged from 11.5 to 12.2 with the same degree of contamination. Pretreatments of less than 3.0 lb./bbl. monosodium orthophosphate were not effective in maintaining the pH of the mud at its orginal value upon contamination with as much as 5.0 lb./bbl. cement.

Figure 2B shows the effects of cement on the viscosity of untreated and monosodium orthophosphate treated natural mud. The original Stormer viscosity (600 rpm) of the natural mud was ten centipoises. The addition of 3.0 lb./bbl. monosodium orthophosphate to the mud had practically no effect on its viscosity and was effective in preventing flocculation of the clay and in maintaining the viscosity at 18 centipoises or less over a 24-hour period after contamination with as much as 5.0 lb./bbl. cement. The untreated mud was flocculated and unworkable viscosities obtained within 15 minutes upon contamination with as little as 1.0 lb./bbl. cement. Pretreatments of less than 3.0 lb./bbl. monosodium orthophosphate are not effective in maintaining the viscosity of the mud at approximately its original value over a 24-hour period if the cement contamination is as high as 5.0 lb./bbl.

Figure 2C shows the effects of cement on the water loss of untreated and monosodium orthophosphate treated natural mud. The water loss of the natural mud decreased from 16 cc./30 minutes to 12.5 cc. upon the addition of 3.0 lb./bbl. monosodium orthophosphate. The water loss of this treated mud did not change over a 24-hour period upon contamination with as much as 5.0 lb./bbl. cement, whereas the water loss of the untreated mud increased from 16 cc./30 minutes to 170 cc. upon contamination with the same amount of cement. Pretreatments of less than 3.0 lb./bbl. monosodium orthophosphate are not effective in maintaining the water loss of the natural mud at or below its original value if the cement contamination is as much as 5.0 lb./bbl.

The viscosity, water loss, and pH of the natural mud treated with 3.0 lb./bbl. monosodium orthophosphate were, after contamination with as much as 5.0 lb./bbl. cement, approximately the same as the original untreated natural mud. The effectiveness of monosodium orthophosphate in pretreating such a mud for cement contamination is due to the removal of the troublesome calcium ions, from the calcium hydroxide in the cement, as insoluble calcium phosphate.

The stoichiometric relationship between monosodium orthophosphate and calcium hydroxide shows that 1.0 pound of monosodium orthophosphate is equivalent to 0.925 pound of calcium hydroxide. The preliminary investigations have shown that 1.0 lb./bbl. monosodium orthophosphate will not effectively pretreat a natural mud against a contamination of 1.0 lb./bbl. cement which contains far less than 0.925 lb/bbl. calcium hydroxide. Yet 3.0 lb./bbl. monosodium orthophosphate will effectively treat the same natural mud against contamination with as much as 5.0 lb./bbl. cement.

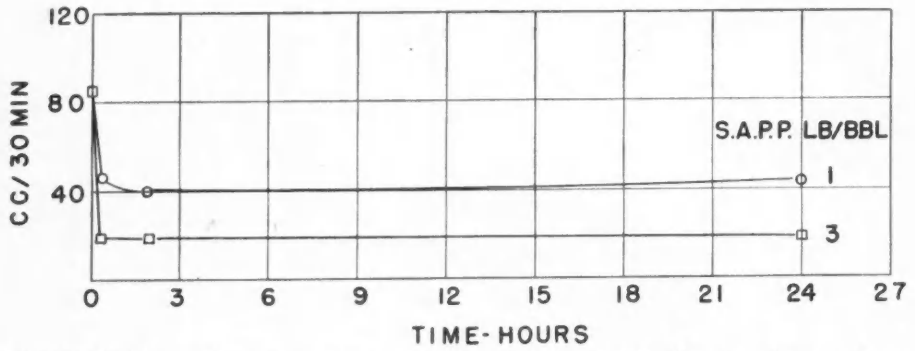


FIGURE 3A. Effects of pyrophosphate on water loss of mud containing three pounds cement per barrel.

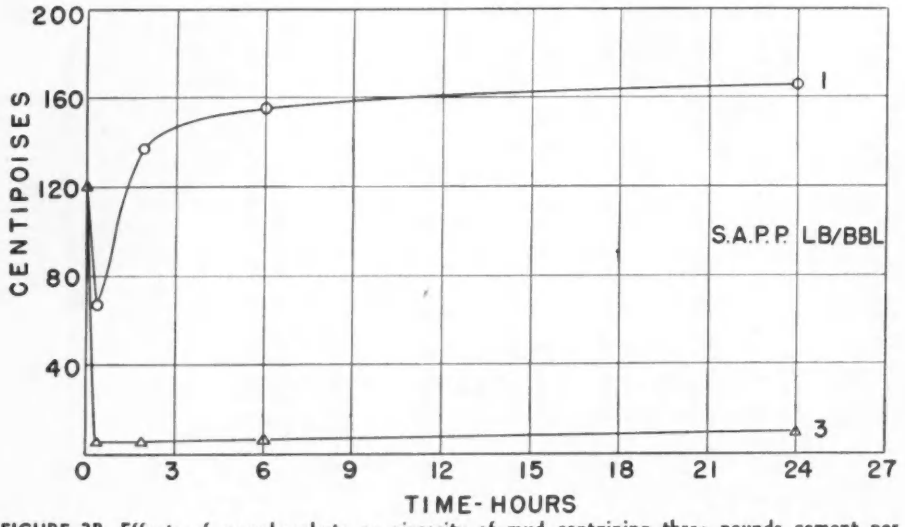


FIGURE 3B. Effects of pyrophosphate on viscosity of mud containing three pounds cement per barrel.

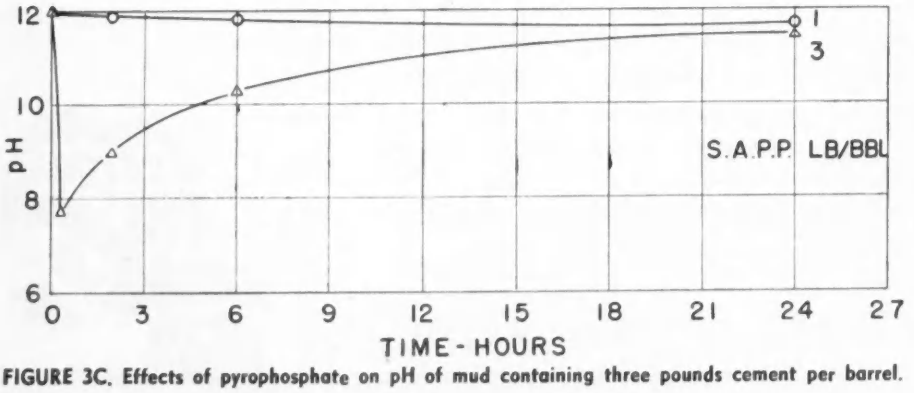
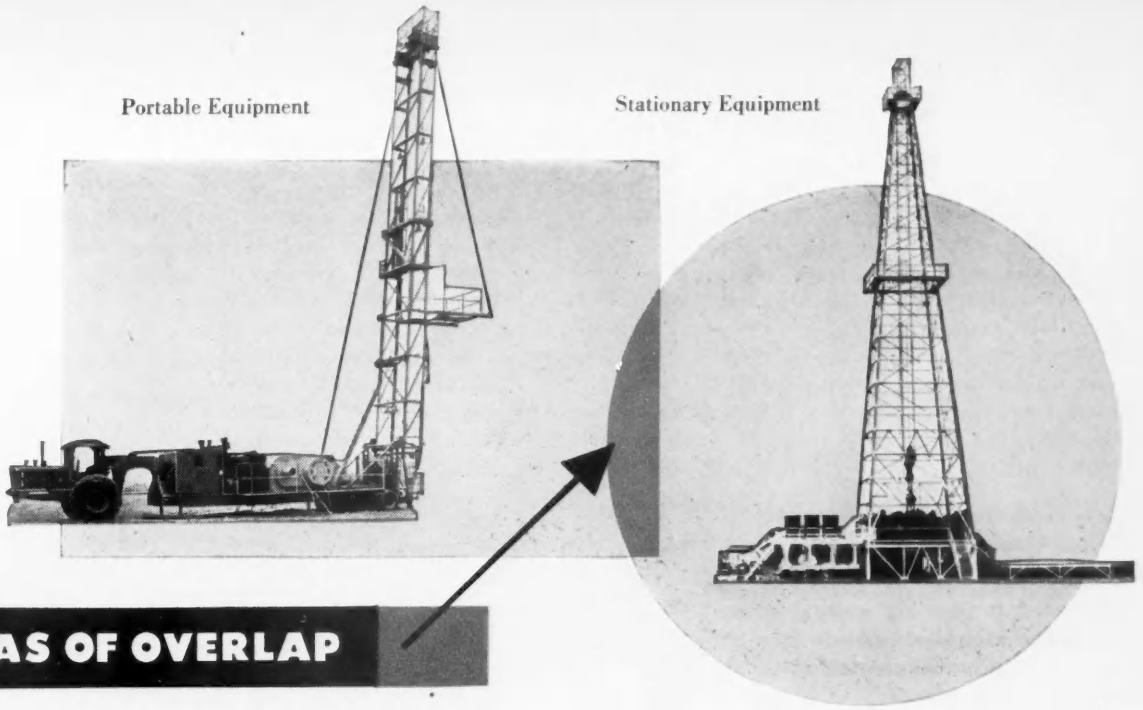


FIGURE 3C. Effects of pyrophosphate on pH of mud containing three pounds cement per barrel.



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Cleveland, Ohio

In this investigation insufficient treating tests were made to establish the relationship between monosodium orthophosphate and cement in drilling muds but it is apparent that it is not the same as the stoichiometric relationship between monosodium orthophosphate and calcium hydroxide.

In treating inert clays such as an El Paso clay slurry for cement contamination a pretreatment of 1.0 lb./bbl. monosodium orthophosphate was sufficient to maintain the viscosity, water loss, and pH at approximately the original untreated clay slurry if the contamination is not in excess of 3.0 lb./bbl. cement.

Post-Treatment with Sodium Acid Pyrophosphate

Since sodium acid pyrophosphate is widely used in treating natural muds for viscosity control, its effectiveness in treating natural muds contaminated with cement was determined.

Figure 3A shows the effects of sodium acid pyrophosphate on the water loss of a natural untreated Gulf Coast mud contaminated with 3.0 lb./bbl. cement. The addition of 1.0 lb./bbl. sodium acid pyrophosphate to the contaminated mud reduced the water loss from 85 cc./30 minutes to 40 cc. An increase in the sodium acid pyrophosphate treatment to 3.0 lb./bbl. reduced the water loss to 18 cc./30 minutes, which was approximately the water loss of the mud before contamination.

This reduction in water loss upon the addition of sodium acid pyrophosphate is due to the removal of calcium ions from the slurry as the result of their reaction with the pyrophosphate to form insoluble calcium pyrophosphate, as shown in the equation:

$$Na_2H_2P_2O_7 + 2Ca(OH)_2 \rightarrow Ca_2P_2O_7 + 2NaOH + 2H_2O$$

Figure 3B shows the effects of sodium acid pyrophosphate on the viscosity of the natural mud contaminated with 3.0 lb./bbl. cement. The addition of 1.0 lb./bbl. sodium acid pyrophosphate resulted in a slight immediate decrease in the viscosity but was not sufficient to prevent a sharp increase in the viscosity within 30 minutes after treating. The viscosity of the contaminated mud was reduced to and maintained at approximately 10 centipoises over a 24-hour period by the addition of 3.0 lb./bbl. sodium acid pyrophosphate.

Figure 3C shows the effects of sodium acid pyrophosphate on the pH of the natural mud contaminated with 3.0 lb./bbl. cement. A treatment of 3.0 lb./bbl. sodium acid pyrophosphate, while effective in lowering the water loss and viscosity of the contaminated mud, has but relatively little effect on the pH. An immediate decrease in pH resulted from the addition of the low pH pyrophosphate solution, but as the reaction between the pyrophosphate and calcium hydroxide proceeds hydroxyl ions are liberated and the pH steadily increases reaching approximately its original value after 24 hours.

Natural clay drilling muds which have been subjected to heavy sodium acid pyrophosphate treatments during the drilling of a well are more resistant to the adverse effects of cement than natural untreated muds due to the presence of monosodium orthophosphate in the field treated muds.

Natural untreated clay muds can be effectively pretreated with monosodium orthophosphate to prevent changes in viscosity, water loss, and pH upon contamination with cement.

Sodium acid pyrophosphate will effectively reduce the viscosity and water loss of cement contaminated natural muds but has relatively little effect on the pH of such muds.

ACKNOWLEDGMENT

The author wishes to express his appreciation to Stanolind Oil and Gas Company for permission to prepare and present this paper; to T. H. Dunn for helpful suggestions and criticisms; and to J. L. Lummus for his assistance in conducting the laboratory tests.

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About the Author

RAYMOND W. JONES is a graduate of Oklahoma A and M College from which he received his M. S. degree in 1932. His first assignment after graduation was as assistant chemist in the U. S. Customs Assay Office at Kansas City, Mo., after which he was appointed head of the Chemistry Department at Oklahoma Military College at Claremore, Okla., Since 1944 he has been associated with Stanolind Oil and Gas Company as a chemist in the Production Research Department.

A Well Completion Technique

■ CONTINUED FROM PAGE 104

run in the hole and cemented, using two cementing plugs to carry the cement down. After the cement had hardened, the combination sand pump-drilling bit was run in the hole and drilling on the plugs commenced. As the tool was dumped, salt water was noted in the fluid coming from the loading chamber, indicating an unsatisfactory cement job. Careful drilling enabled the operator to cut out only the cementing plugs, leaving the cementing shoe intact in the hole for a later squeeze job. However, it was decided to drill out the cementing shoe and try a second cement job. The tool was run back in the hole and the shoe drilled out. Upon recementing the hole with a retractable casing packer, 199½ feet of cement were left in the well. Approximately 195 feet of solid cement were removed by the combination sand pump-drilling bit, when apparently a collapsed section of pipe was encountered. After subsequent operations, the well was abandoned as dry. This operation is illustrated as Case 1 and Case 2 (page 103).

A second well, shown as Case 3, in the Truxno area, was drilled to the cap rock and 5½-inch casing cemented. Approximately 50 feet of drilling mud, too heavy for a dart-type bailer to remove, had to be taken from the well. A wooden cementing plug, 84 feet of cement and a plastic float shoe had to be drilled. Drilling was continued through four feet of cement below the float shoe and then five feet into the producing formation. Total time required was 40 hours. The well is a good producer.

An interesting case in the Farmerville field, Case 4, involved removing heavy drilling mud, two wooden cementing plugs, plus the float shoe. Not more than one foot was drilled into the pay sand before drilling was stopped. While waiting for pumping equipment, the fluid level continued to rise until it slopped over the top. Total drilling time was estimated to be 9½ hours.

While the most common application of the tool in the past has been in drilling out heavy mud, cement columns, cementing plugs and casing float shoes, experience has clearly indicated that such a technique as described above can be employed economically and with the minimum of contamination to the formation. Success of this completion technique in the low-pressure, shallow formations of Northern Louisiana points to other applications of a similar nature where the rotary is used and a cable tool completion is desired. Because of its size and construction, the tool lends itself to completion jobs in higher pressure areas through the use of a lubricator.

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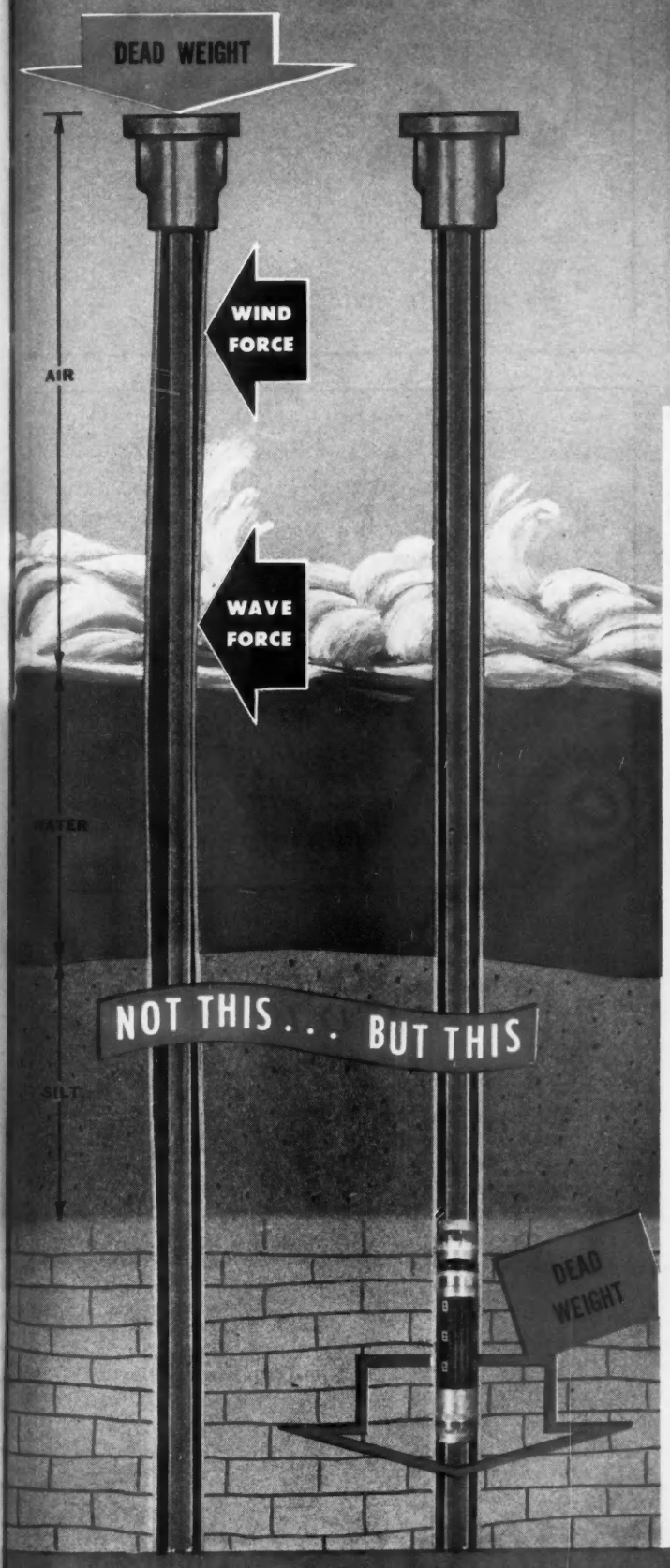

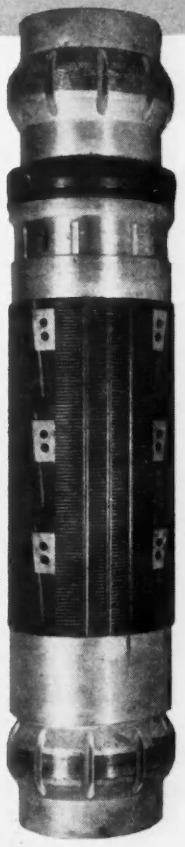

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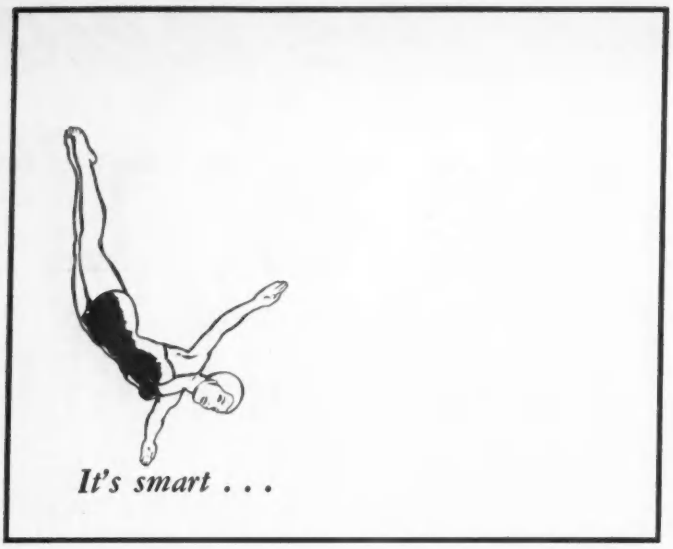

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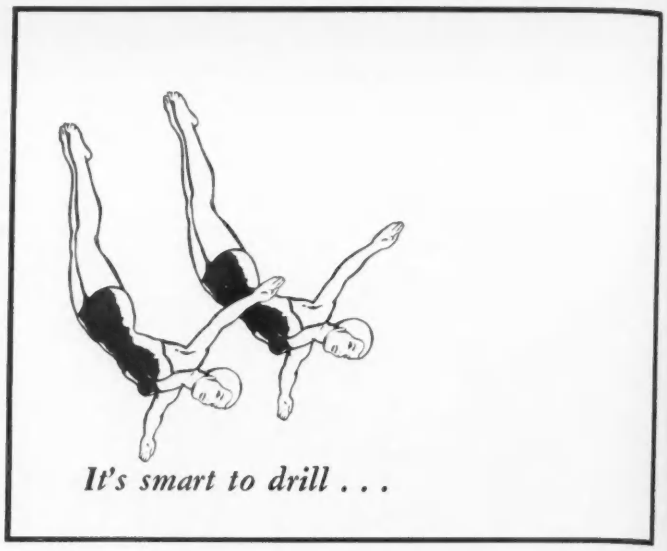

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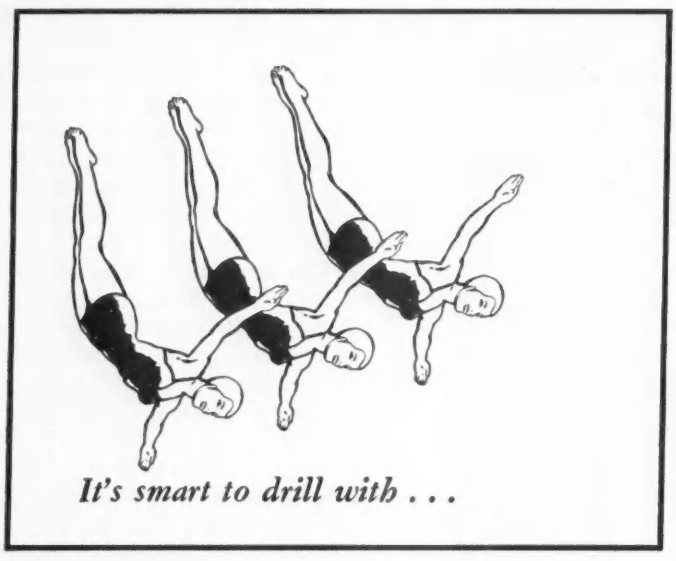

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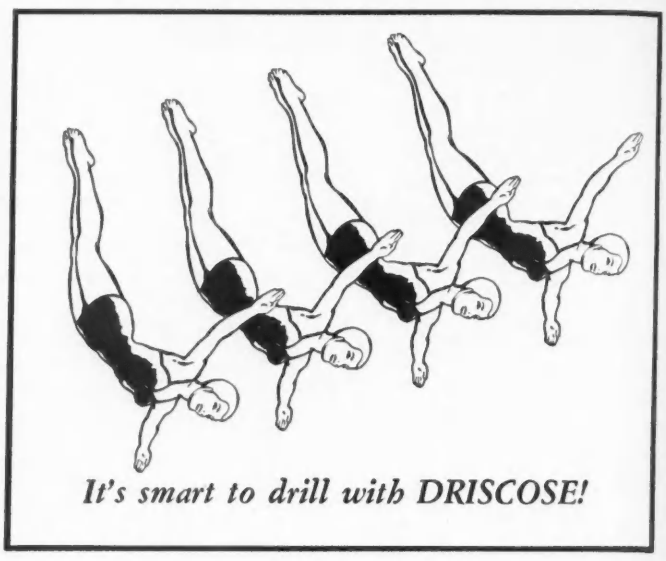

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The Pure Oil Company's Tideland Development

By I. W. ALCORN

Division Production Engineer, The Pure Oil Company, Houston

OUT OF The Pure Oil Company's drilling operations in the Creole field in the Gulf of Mexico off Cameron Parish and in Sweet Lake came ideas that proved invaluable in coping with offshore drilling problems. Outstanding features of this offshore structure that make it different from others are presented. Pure purchased the first LST for conversion in offshore drilling, and at present is the only company to operate such a vessel as a self-propelled unit.

RECENT developments in the tidelands of the Gulf of Mexico and on the continental shelf immediately adjacent command heightened interest due to their widespread distribution and to their covering many conditions of water depth and various distances from port.

First drilling in the open waters of the Gulf started October 6, 1937, a joint operation of The Superior Oil Company and The Pure Oil Company. Location was 6000 feet offshore from Creole, La., in 14 feet of water, measured at mean low tide. This well was completed as the first commercial oil discovery in the Gulf of Mexico waters, and was known as the Creole field. In 1941, Superior and Pure built a second outpost structure at Creole.

During the war years, activity in these areas was discontinued, but renewed with increased effort following removal of the submarine menace. This activity was stimulated by greater demand and higher prices for petroleum. The literature contains many articles on these operations, both current and of recent completion. These postwar activities resulted in several important oil discoveries.

Location and Design of Structure

The latest development of Pure is approximately nine miles offshore from the Louisiana coast line, and about 54 miles east of Cameron, La. (Figure 1). Cameron was selected as the operating base since it was the nearest port from which operations could be served. The great distance involved, however, precluded the transfer of personnel to and from the structure at the end of each shift.

It was early recognized that to carry on such operations it would be necessary to procure suitable ocean-going floating equipment. To satisfy this need an LST was acquired in February, 1947, from War Surplus Administration. This craft was converted to serve as a construction vessel and drilling tender. A 45-ton full-revolving crane was mounted approximately 'midships, the conversion complying with the requirements of the Coast Guard and the American Bureau of Shipping. The ship was retained as a self-propelled vessel and assigned a minimum ship's crew. To date this plan has worked out most satisfactorily and without undue burden, at the same time offering many advantages.

In designing the drilling structure or platform recognition was taken of several requirements: (1) the platform must be as economical as possible consistent with the physical requirements of loading, wind and wave action; (2) the design should lend itself to economical salvaging; and (3) it should be suited for the drilling of a number of wells in the event production is obtained.

Since early 1940, Pure has successfully employed a floating drilling barge in its Sweet Lake development.[1] Its layout is similar to current practice and methods in use for some years in Lake Maracaibo, Venezuela. For open water work the setup is greatly enlarged. This initial structure is not reduced or modified to its fullest extent; however, personnel accommodations, water, fuel, dry mud, cement, pipe, etc., are carried by the floating tender.

The platform is constructed in two parts (Figure 2). The drilling structure is 50x98.5 feet, and is supported by 14 piles 36 inches in diameter with a wall thickness of five-eighths inch. Each pipe is driven to 80 feet of penetration and topped at 25 feet above mean low tide in 38 feet of water. The pipe rack is 56x60 feet and is supported by 12 piles 24 inches in diameter with one-half inch wall thickness. They are driven to the same depth as piling in the drilling structure.

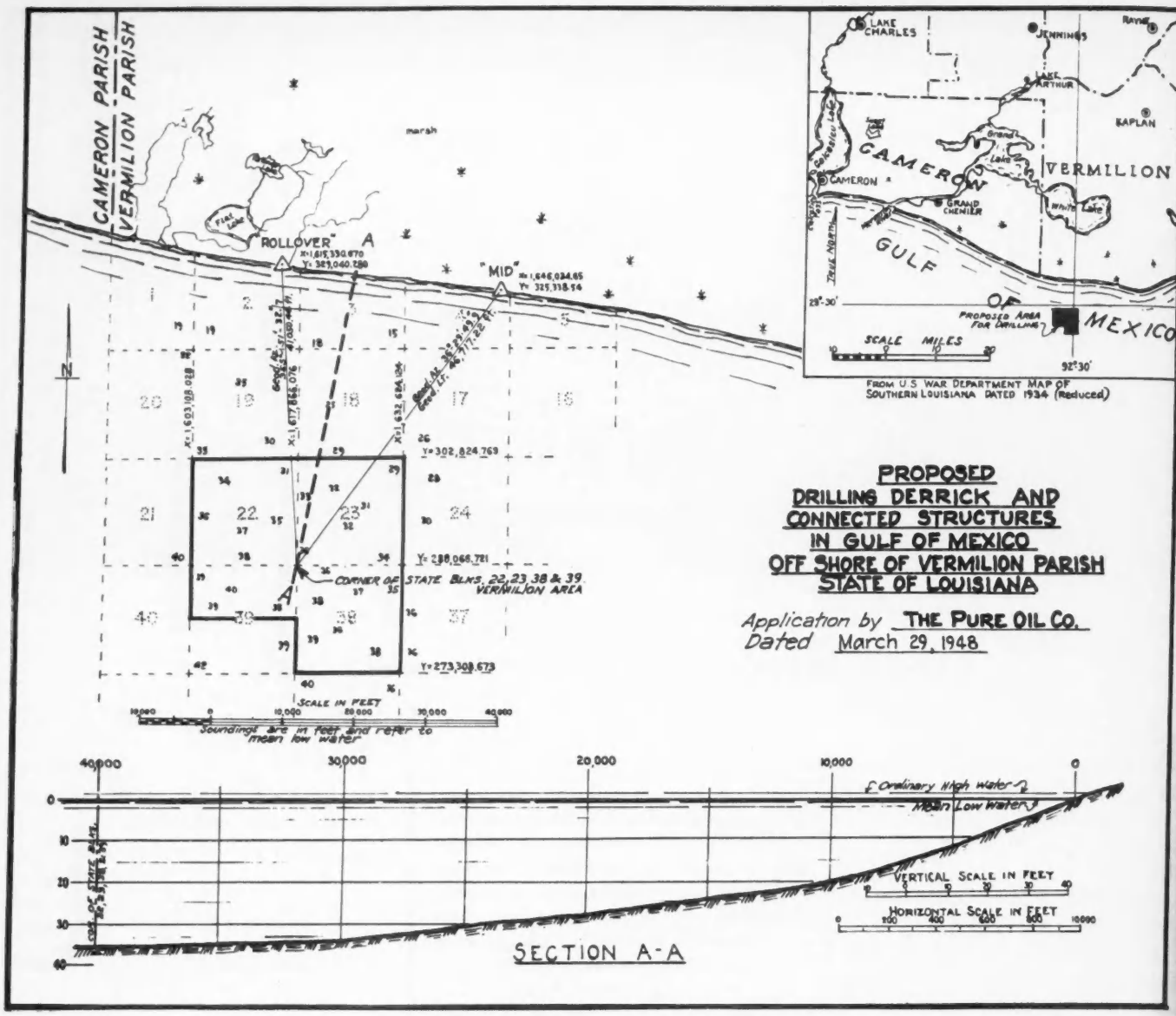

FIGURE 1. Location of Pure's structure in the Louisiana tidelands.

The 36-inch diameter piling was designed for 200,000-pound vertical loading and 3000 pounds per square foot horizontal wave action. A factor of 1/5 was used for round surfaces of piling, reducing the estimated figure to 600 pounds per square inch in effect over the vertical distance affected by wave action. The portal bracing was fabricated from 6⅝-inch diameter, half-inch wall thickness drill pipe with heavy gussets at connecting points to 37-inch internal diameter by 20-foot covers placed over the piles. Horizontal transverse braces are are provided on the short ten-foot centers. The piling is capped with 33-inch, 220-pound WF (wide-flange) sections. Across these beams are placed 18-inch, 77-pound stringers to which three-inch wood decking is secured.

Unusual in the construction practice of such a structure was that of omitting the driving of a test pile. This was not done for several reasons: (1) high cost of driving test piling and/or coring; (2) recognition that pile-driving formulas are not very reliable where the major factor of bearing is skin friction; and (3) extensive past experience has dictated the approximate bearing that could be expected in pounds per square foot of friction surface. As final assurance, however, and in view of the magnitude of such work to be done in the future, it was felt desirable to make a dead-weight test. For this purpose a 1000-barrel tank was fabricated with a 37-inch internal diameter opening through the center, support being effected by beams across the top of the tank and tied to the sides (Figure 3).

Ten piles were driven to grade before the dead-weight test was made. Pile No. 8 was selected for testing as most suitable for bracing and guying to other piles. The tank was then filled with sea water and the dead-weight load of 200 tons applied. Two inches of settlement occurred after the 350,000-pound mark had been reached. A six-inch quick-opening valve drained the tank in 22 minutes. When the tank was empty the indicator rose one inch. It is believed that the two-inch settlement represented spring or give in the supporting elements of the tank rather than actual settling of the pile. This test was made approximately 24 hours after the pile had been driven.

The results of this dead-weight test indicate that with 80 feet of penetration of 36-inch outside diameter pipe the bearing is equivalent to at least 530 pounds per square foot and that the calculated working load of 200,000 pounds per pile is amply safe as this required only 265 pounds per square foot, or a factor of safety of two. These figures were in the range of what was expected, however such data naturally cause wonder as to how far it would be safe to go in reducing penetration. Further work with the test tank is proposed to eventually develop such information.

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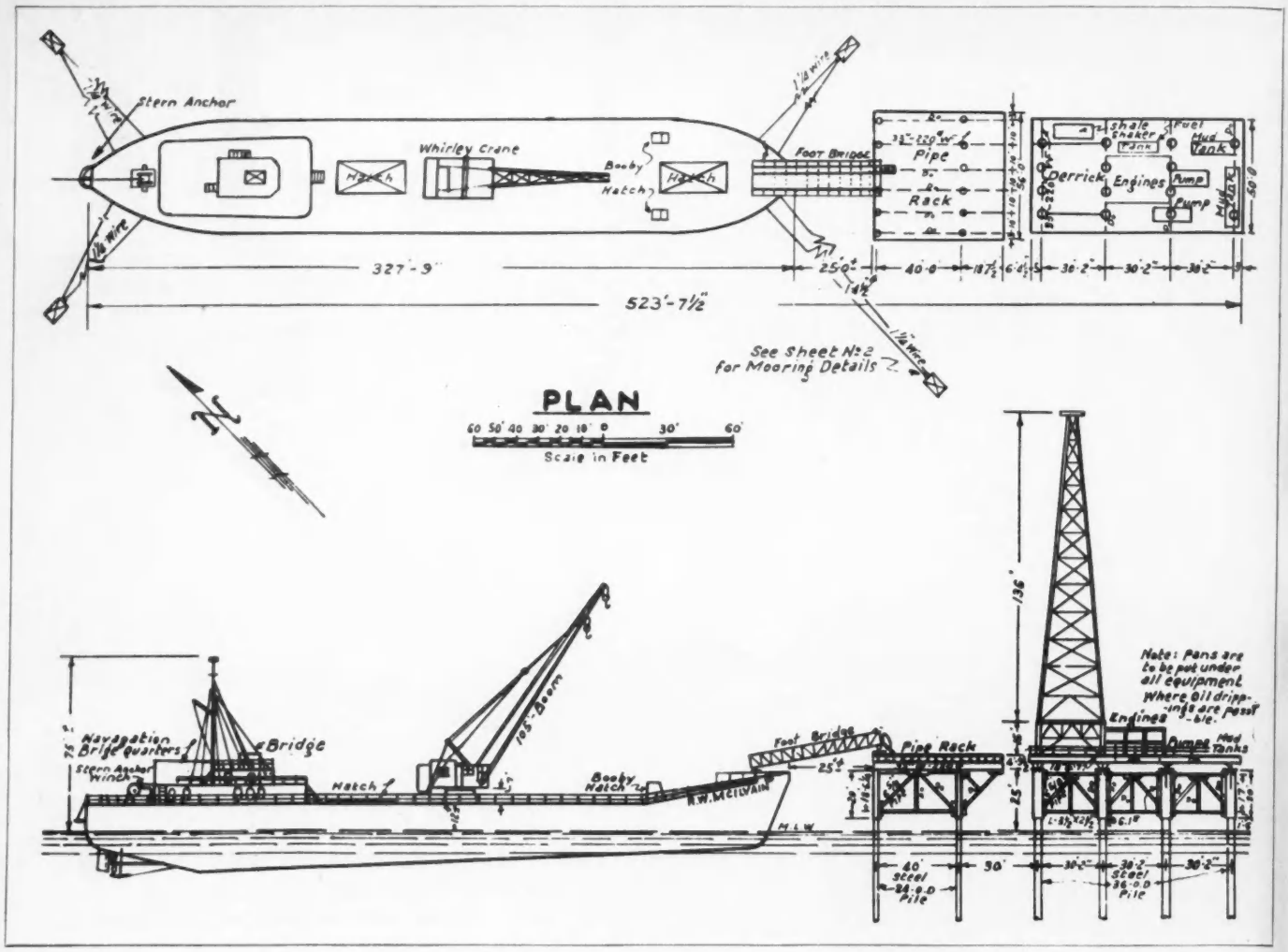


FIGURE 2. Side elevation of platform structure and its relation to the floating tender.

The LST "R. W. McIlvain" was converted to serve as a construction vessel and drilling tender. This article will deal only with the construction phase. Pure elected to provide all construction facilities and tools. The necessary skilled labor and construction know-how were engaged on a basis of labor cost plus a fixed fee.

Construction Equipment

Major items of equipment required were, in addition to the floating equipment: six electric arc-welding units; three 500-cubic foot, 100-pound air compressors (to which was later added an additional 300-cubic foot machine); air tank; an air hammer; hammer leads; pneumatic winches; 24- and 36-inch pipe clamps for vertical welding on piling, and a floating template (Figures 4 and 5). The floating template proved very successful. The design permits telescoping to alter spacing and a bushing to accommodate either 24- or 36-inch piling.

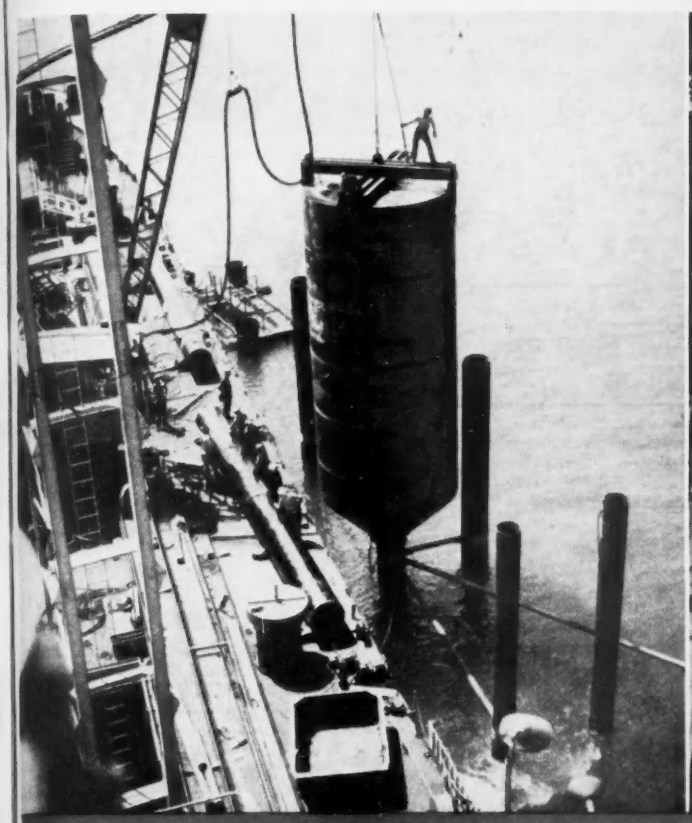
Air rather than steam was used for the hammer due to stringent Coast Guard requirements on the operation of steam boilers. The starting piles were welded up into 104-foot lengths, to which was later welded a 40-foot section. Slip joints of 37-inch and 25-inch by 20-foot length with suitable pile caps were installed. To these slip joints was welded the prefabricated bracing. Most of the piling was plugged and lashed in tows of five or six joints and towed to location (Figure 6). Other than this, all construction material, together with all galley supplies, water and fuel, were taken aboard the LST to complete the job.

Construction work started May 14, 1948, with the driving of the first anchor pile. Completion was on the morning of July 2, 1948. The operation was conducted on a 24-hour, seven-day basis. Total number of men employed in the ship's crew, including relief, was 39. Nineteen were in the steward's department, 6 in the engine room, 12 in the ship's deck crew, and 2 were electricians. The construction force was composed of 34 men, working on a 12-hour, seven-day basis.

Being on a self-propelled vessel, the ship's crew carry on their normal duties while going to or returning from location. While ship is moored, they handle the mooring winches, etc., and generally

About the Author

I. W. ALCORN, a pioneer of oil's new frontier in the open Gulf, is division production engineer for The Pure Oil Company, Houston. He became confronted with offshore drilling problems as early as 1937. Structures in the Creole field, a mile off the Louisiana shore, still stand and the field continues to produce. Since that time, he has developed drilling equipment to meet the unusual conditions in marine drilling. Accelerated interest and activity in the open waters of the Gulf of Mexico and the exceptional prospects for oil there have taken him further into the problems of drilling in the open sea.



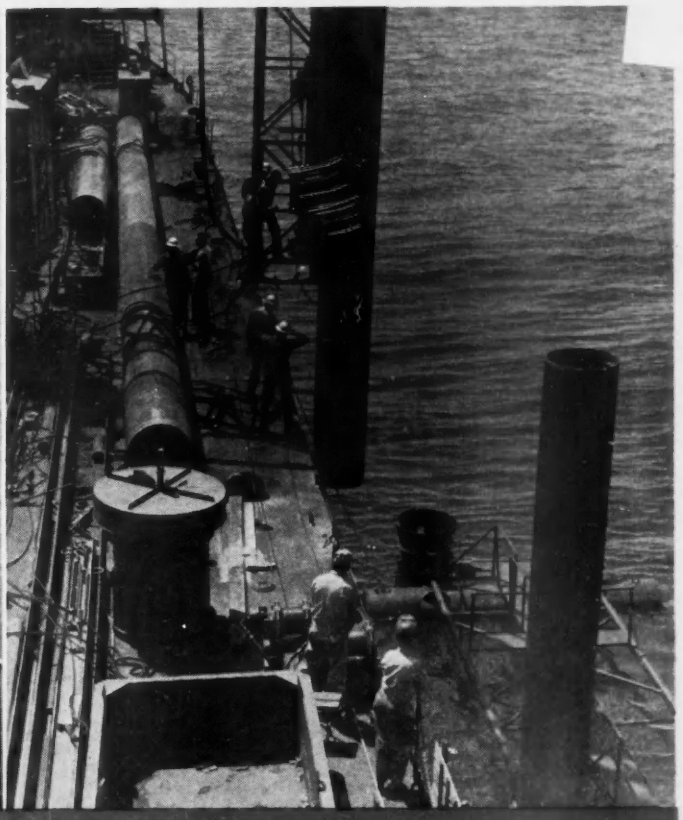


FIGURE 3 (Left). The 1000-barrel tank set over pile No. 8 to make a dead-weight test. Horizontal members support the pile during the test.

FIGURE 4 (Right). Placing piling in floating template.

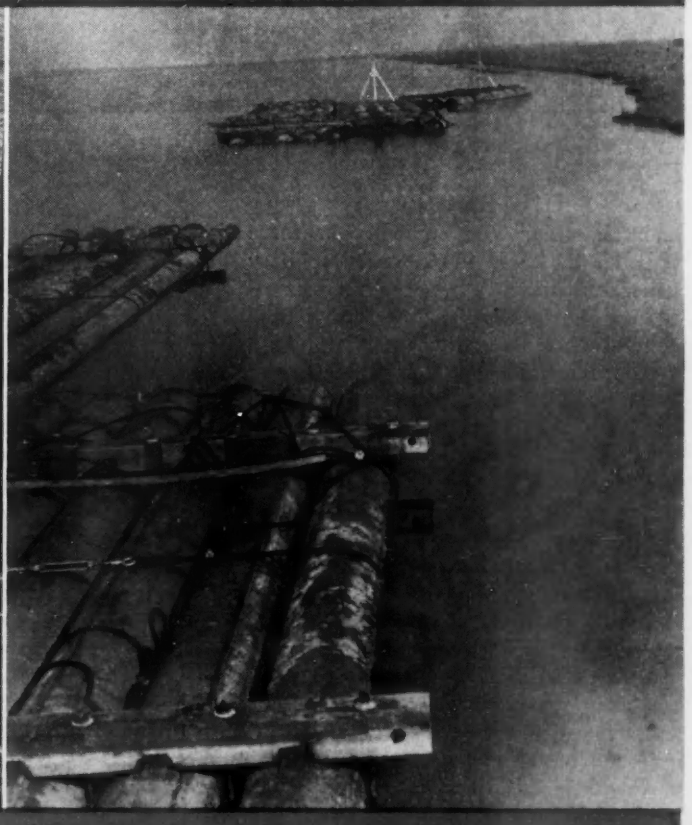


FIGURE 5 (Left). Piling has been driven and floating template has been removed, and may be seen in the background. Welders are adding a 40-foot section to the pile.

FIGURE 6 (Right). Method of lashing the 104-foot lengths of pile together for floating to location.

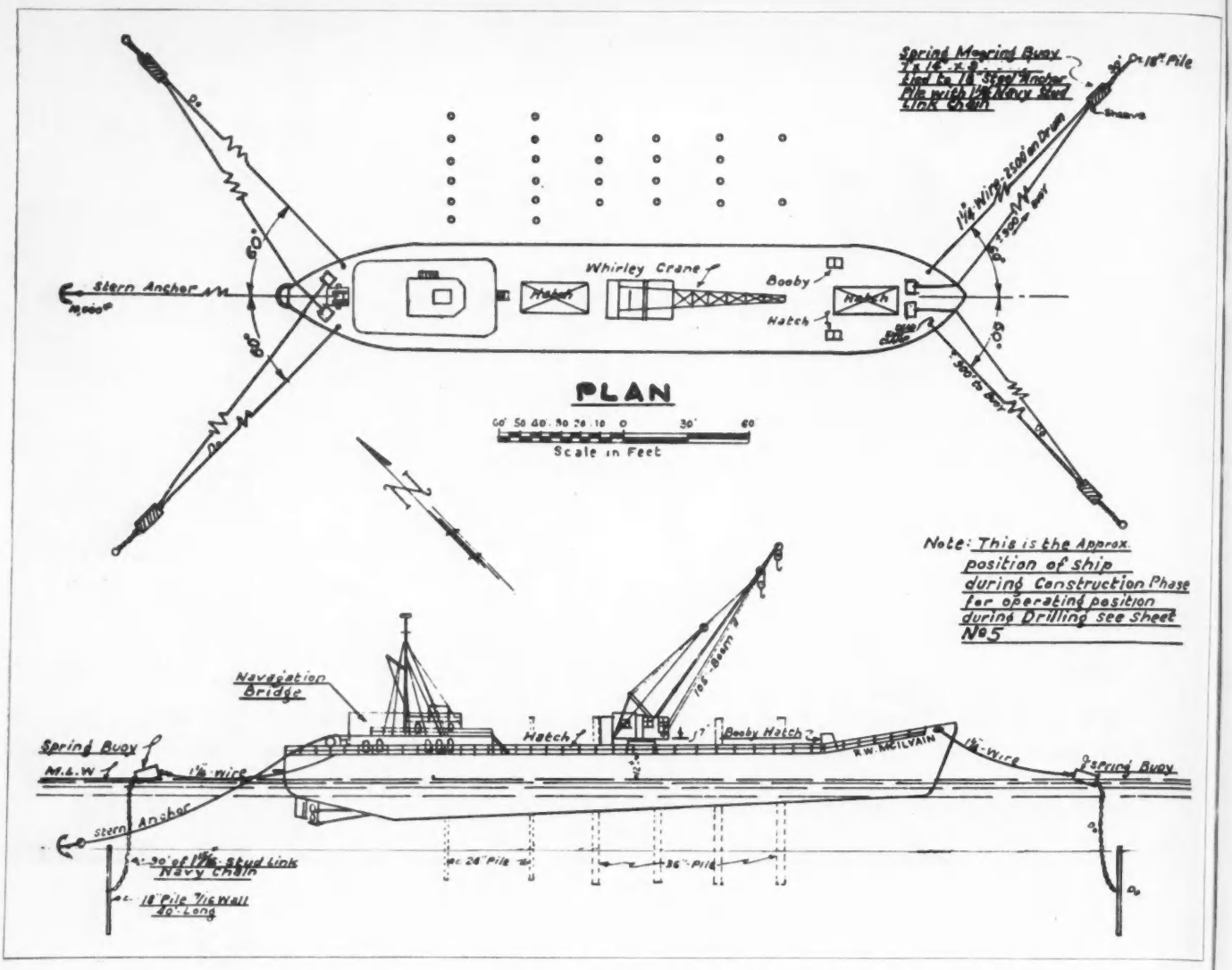


FIGURE 7. Side and top view of mooring plan for the floating tender. This method of mooring is new to drilling operations in the Gulf.

maintain ship. The engine-room force operates the three 100-kilowatt auxiliary generators which power the crane, ventilating equipment, lights, radio, and general power requirements.

Approximately 700 tons of steel were involved in the structure, including piling. Several types of protective coatings were applied to mitigate corrosion from the sea water. Inside the piling, salt water was jetted out and replaced with fresh water to which had been added 20 pounds of caustic soda and five gallons of waste oil.

It was initially recognized that proper mooring of the ship was most essential. Considerable inquiry and investigation was made among large eastern concerns and departments of the Navy in Washington. Considering the soft, silty floor of the Gulf off the coast of Louisiana, it was decided to use the fixed pile anchor method with spring buoy to permit the necessary give-and-take of the ship (Figure 7).

The mooring is made by driving 40-foot lengths of 18-inch diameter, half-inch wall thickness pipe flush or a few feet below the floor of the Gulf. Attached to the midpoint of the pile is a 90-foot length of 1-15/16-inch chain. Buoys (Figure 8) were designed for 14,000 pounds net buoyancy and carrying a 30-inch sheave built into the bow or ship side. The chain extends down both sides at the stern and is bridled to the 90-foot length of chain on the anchor pile. A 1¼-inch wire line is then run from the winch on the ship through the sheave and dead-ended back on the ship. This gives a two-part line and permits rapid slipping of the mooring without leaving the ship. A more recent innovation involves the construction of a 12-foot derrick on top of the buoy, from which is hung a bell. Oftentimes the buoy is completely submerged. Recording dynamometers, installed both bow and stern, record accurately the mooring line pulls.

Auxiliary Craft

Two YMS's (Navy mine sweepers) and one APC (Coastal patrol craft) are used for auxiliary craft. One trip per day is made from Cameron to location and return. The schedule is such that one auxiliary stands by at the location at all times. The one going out usually stays and the one which came out the previous day returns. The YMS is considered to be the most desirable craft for this service. It is 136 feet long, twin screw, and powered with two 500-horsepower diesels. It falls below the 300-ton classification, and therefore is not subject to many regulations. This ship is adapted for hauling of both dry and liquid cargo, with ample accommodations for personnel. The trip requires four hours with the YMS and approximately six hours with the APC. Both ships are of standard wooden hull construction. Communications between the Cameron office and the location are provided with 250-watt frequency-modulated transmitters and receivers. One set was installed at the Cameron office and another on the LST at the location. Excellent communications have been maintained at all times. The antenna at the shore location is approximately 150 feet high, and that on the LST is about 75 feet above the water.

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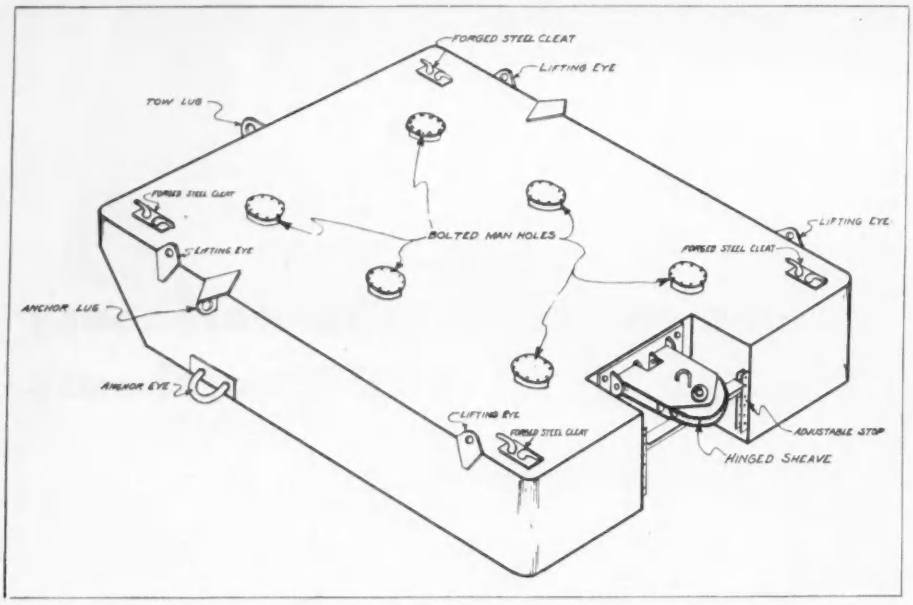

FIGURE 8. Oblique view of LST mooring buoy invented by the author.

cations, the LST is equipped with a 75-watt, amplitude-modulated set, and each of the auxiliaries is equipped with a 40-watt set. All units have ship-to-ship, ship-to-shore and Coast Guard channels. Due to the large number of stations assigned these frequencies, the AM communication has not been very satisfactory, due both to interference and to static.

While Pure has pioneered the smaller, modified drilling structure for marine work on the Gulf Coast, the present structure was built somewhat larger, pending additional information on the action of the LST in open water. It is now believed that the structure can be reduced to one-third its present size by certain alterations of the ship and type of rig. Salient features of this project are that Pure was the first company to acquire an LST for such operations, and also retain it as a self-propelled vessel. The ship is fitted to carry out the construction of the drilling platforms resulting in important economies. The floating template and test tank are considered novel. It is believed that the design of the structure lends itself to practically 100 percent salvageability at minimum cost. The design also lends itself to the drilling of any number of directional wells by expanding the structure, giving a pattern of wells ten feet apart in one direction and 30 in the other. The present method of mooring also represents a novel feature not seen in other offshore projects.

Much knowledge has been acquired in the building of this type of structure. The development is still in a pioneering stage with all operators pursuing the problem according to their individual ideas and conditions. No standard or routine procedure has been established or accepted up to now. Eventually, however, it is hoped that from this pioneering and development work there will emerge a suitable, practical and economical method of development.

REFERENCE

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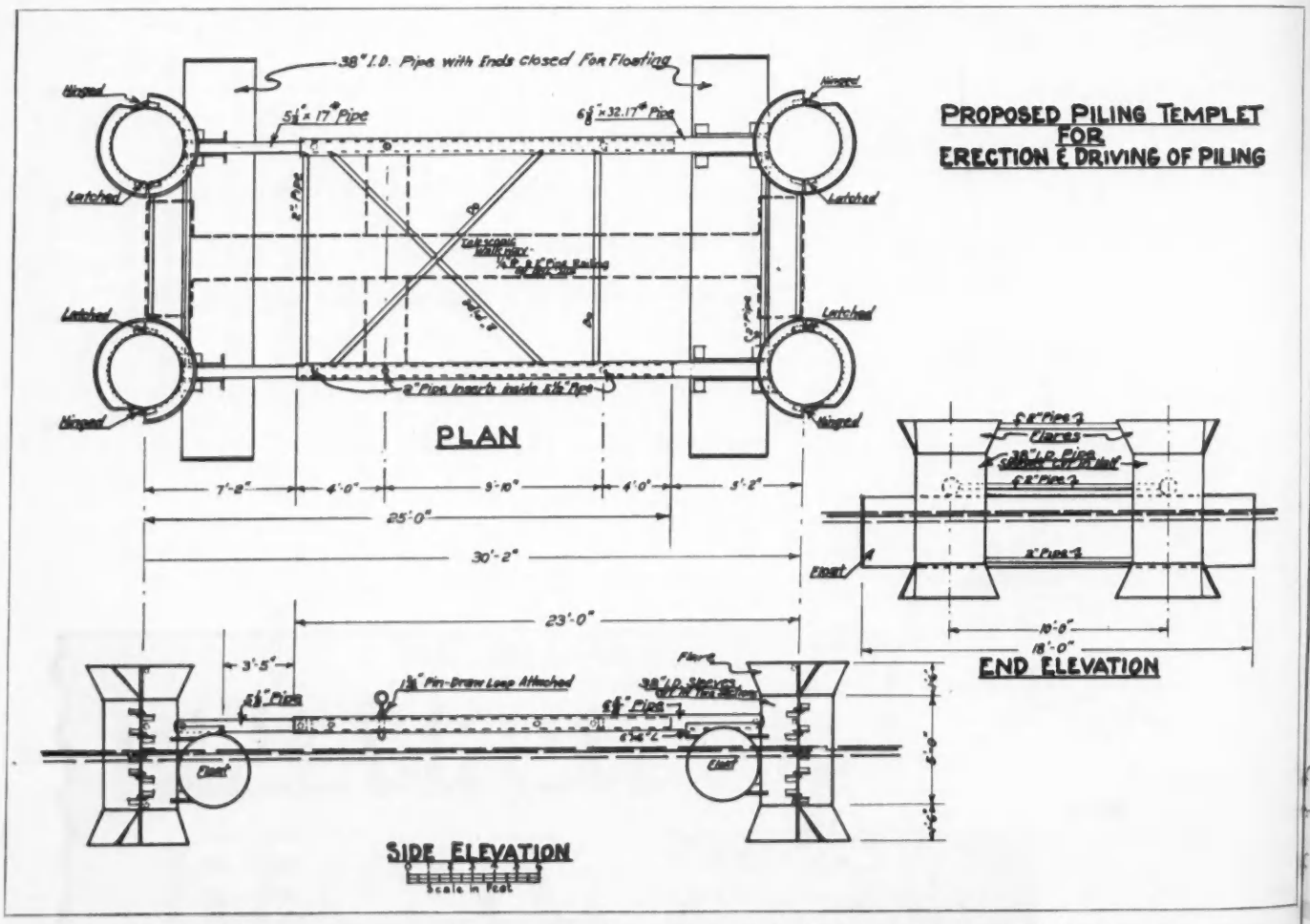
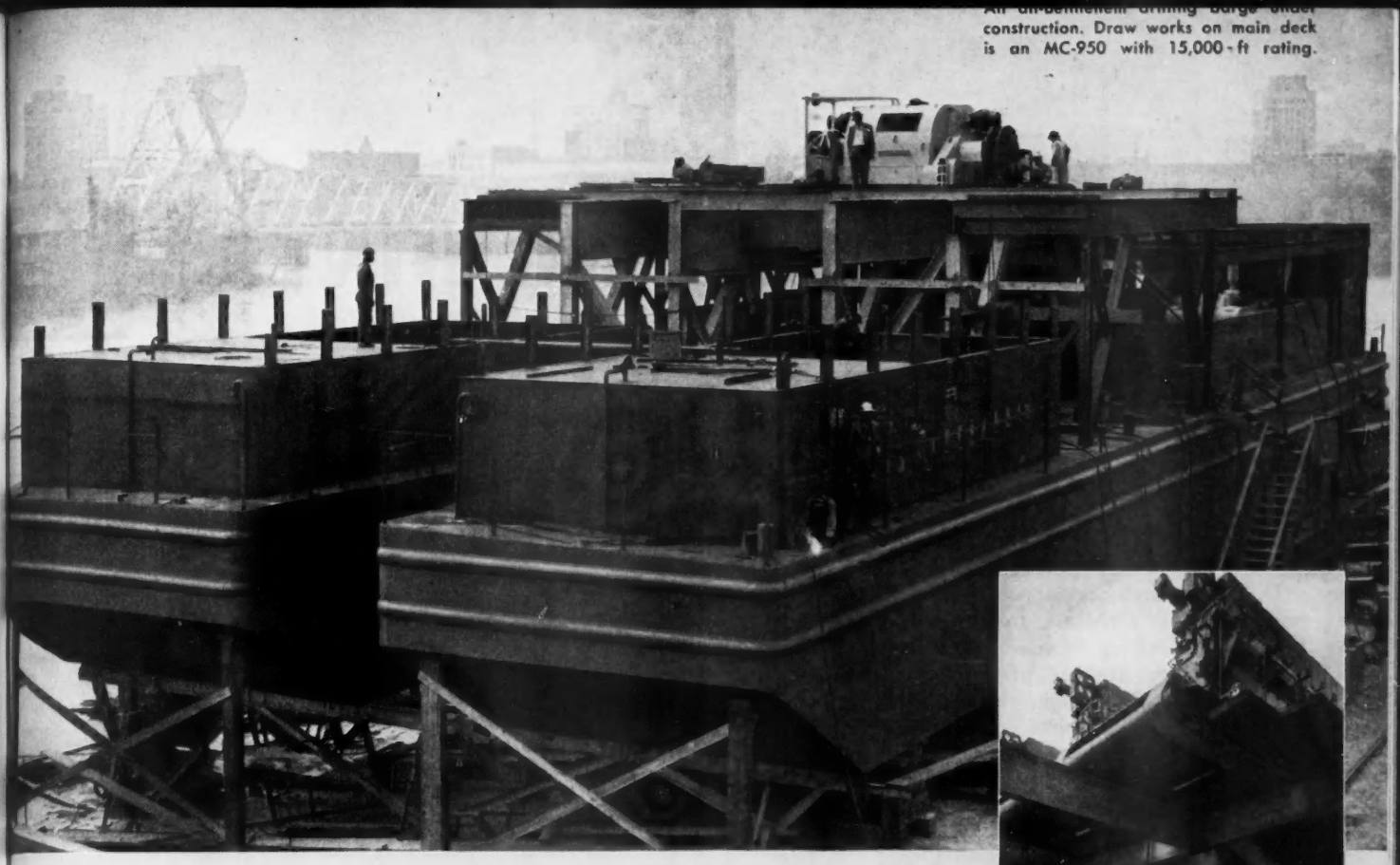


Figure 9. Detail plan of the successful floating template used in guiding the 36-inch piling during driving operations.



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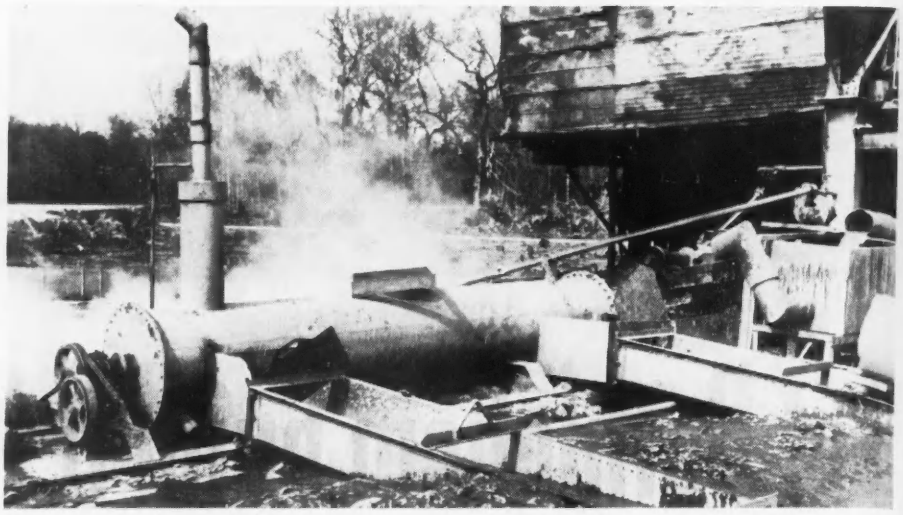
HOW TO—Remove Entrained Gas from Well Drilling Fluids

Drilling in high-pressure areas poses many serious problems to the tool pusher and drilling engineer. One of these problems is that of formation pressure control of high-pressure gas sands. Weight of the mud is increased until the hydrostatic head overcomes the formation pressure. However, there is usually much of this gas trapped in the mud stream, which in effect, lightens its weight. By reducing the viscosity, much of this gas is released once it goes over the shale shakers. However, in some cases, it is difficult to remove all the entrained gas.

The device illustrated was designed and fabricated as a means of further removing entrained gas in the drilling fluid that might be a threat to adequate pressure control in the well. The degasser has been unitized on a skid along with the shale shaker. It is essentially a long cylindrical chamber through which rotate helical paddles. A vacuum is drawn on the chamber by a steam jet built into a vent pipe mounted on top of the degasser.

Mud is diverted through the degasser by gate blocks that can be easily removed when the mud contains no gas. The mud comes off the shale shaker and flows into the degasser. Inside the chamber, a decrease in pressure will permit the lighter gases to be released and be drawn into the atmosphere by the steam jet.

The mud then flows out the opposite end of the device and back into the mud pit. The chamber is about 24 inches in diameter with bolted flanges covering both ends. A packed bearing supports the helical paddles mounted on a long axle which extends the entire length of the unit. Power to rotate the paddle wheel is shown at the extreme left. It can be either an electric motor or steam turbine which has been geared down to the desired speed. Sufficient vacuum can be drawn on the chamber with about 75 pounds of steam to draw mud up into the gas vent.

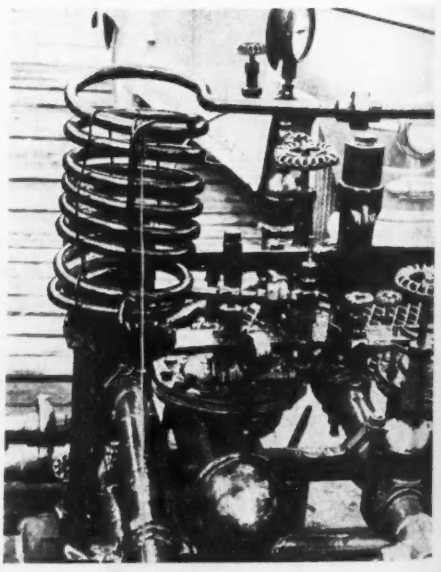


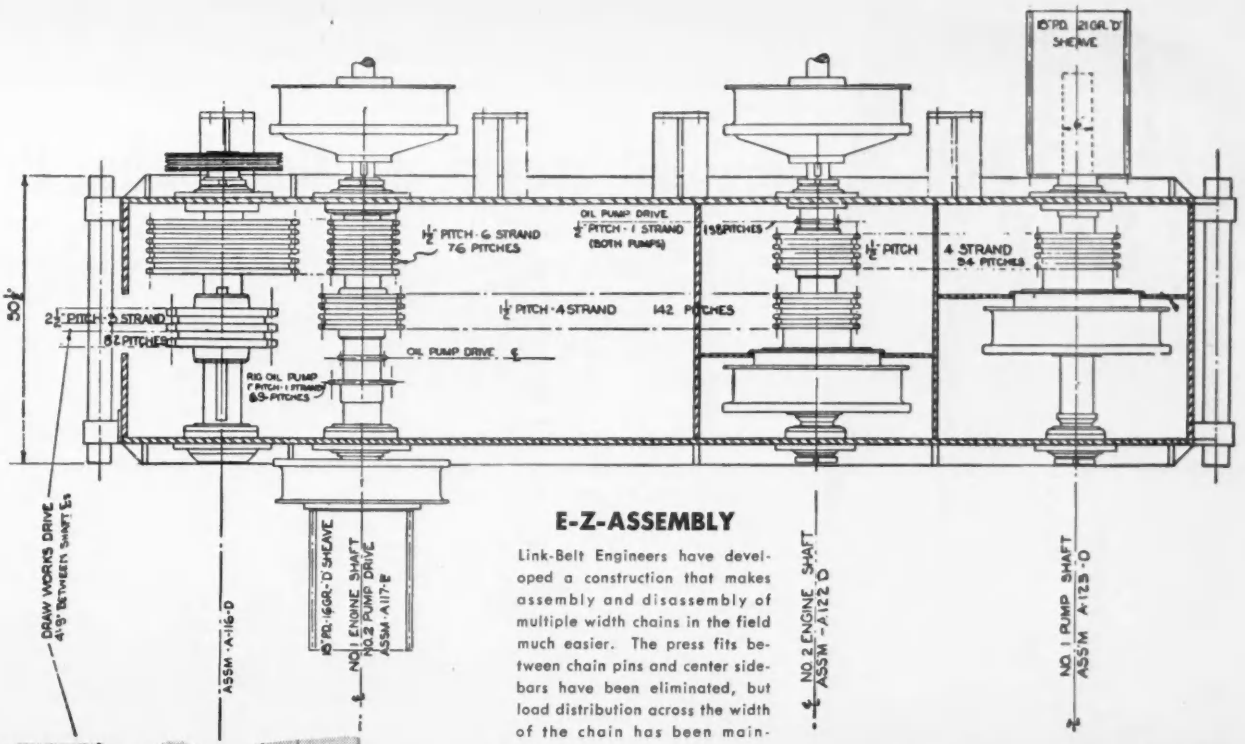
HOW TO—Safeguard Regulator Diaphragm

Regulators which have been adapted for automatic boiler firing equipment are sensitive devices and must remain so if good response is expected. Their diaphragms are normally made from a fabric material which has been rubberized. While these diaphragms will withstand fairly high temperatures, if subjected to steam heat continually, their life will be materially decreased.

The tool pusher of one company installed an automatic steam condenser which prevents high temperatures from reaching the diaphragms of the regulators on automatic boiler firing control units. Steam is piped from the boiler steam header to the firing control equipment through a three-fourths inch line. This line is connected by means of a union to a similar size pipe which has been formed into a series of coils as shown. Outlet from this coil at its lower end connects to the top of the regulator diaphragm body.

By the time steam reaches this coil section, it is sufficiently cooled to condense into water. It is this water that acts as a temperature cushion, while at the same time transmitting the pressure to the regulator.





E-Z-ASSEMBLY

Link-Belt Engineers have developed a construction that makes assembly and disassembly of multiple width chains in the field much easier. The press fits between chain pins and center sidebars have been eliminated, but load distribution across the width of the chain has been maintained.

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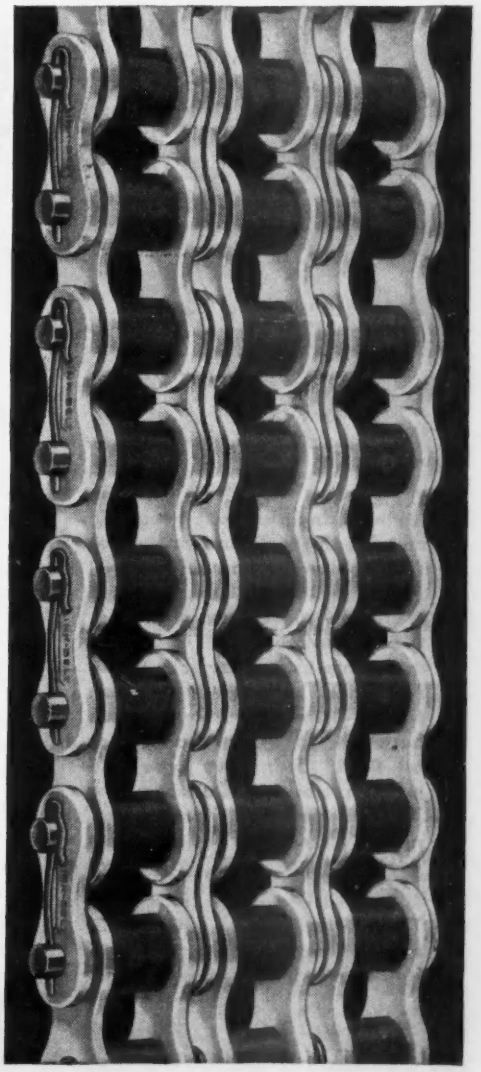
Compound drive for Turney Rig 1250. Link-Belt Silverlink Roller Chains are completely enclosed in dust proof forced-feed oil bath.



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That's why Turney now uses Link-Belt Silverlink as standard equipment on their Super 1250 Rig. On their power drive assembly you'll find two 1 ½" pitch RC-120-4 quad chains on the compound . . . one 2 ½" pitch RC-200-3 triple chain and one 1 ½" pitch RC-120-6 sextuple chain on the input transmission drives . . . as well as other Link-Belt chains.

The compound drive shown here was recently built by Hunt Tool Company for the Turney Manufacturing & Engineering Company. It is now being used by a major oil company to power a Turney rig drilling an off-shore well. And everyone—including Link-Belt—is proud of the job!

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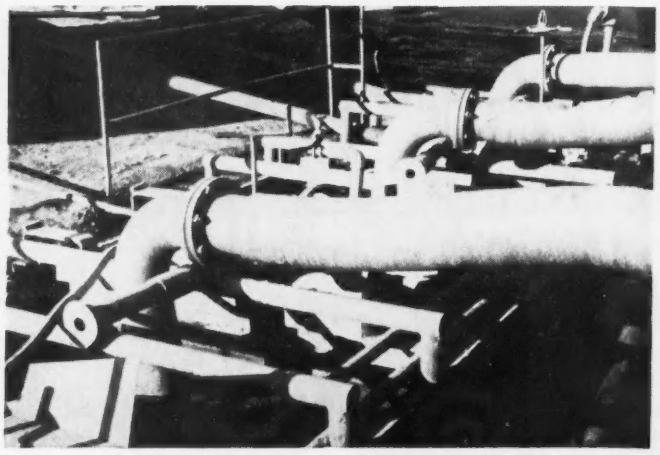
HOW TO—Support and Align Suction Fittings

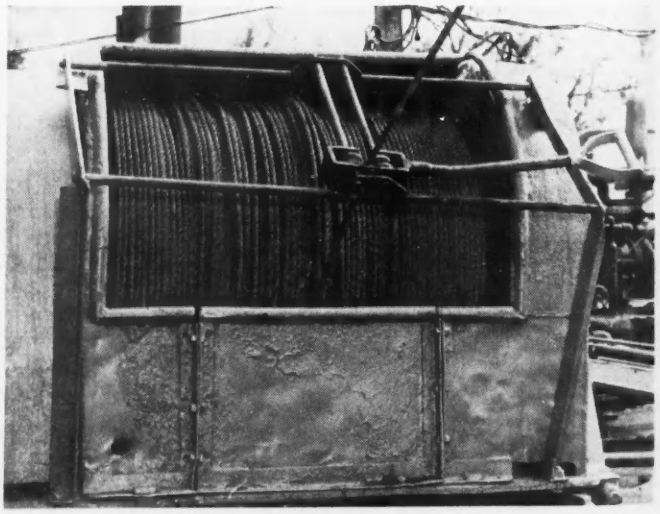


Instead of supporting the suction fittings with timber cribbing in an attempt to align the foot valve with the mud tanks and circulating pumps, the suction end of the hose, with the pipe fittings, can be supported with permanently attached members which become essentially a part of the steel mud tanks. Two crossmembers of two-inch pipe are attached to opposite sides of the mud tank walls with short knees to raise the structure above the equipment.

Midway of the horizontal supports is placed a connecting bar, or pipe with flanged ends to prevent lateral motion. This crossbar, or connecting bar, rests in saddles deep enough to prevent being accidentally misplaced by vibration or pulsation of the pump. The suction line is a vertical pipe with the foot valve submerged in the drilling fluid, and connected to the suction hose by inserting a 45-degree flanged ell.

Inside the angle of the ell is welded a sleeve, or ferrule, which rides on the connecting bar and holds the suction line at the predetermined depth in the mud. Being free to slide the full length of the connecting bar, the ferrule is easily moved to the position which will align the suction riser with the mud pump if it is not practical or convenient to set the pump at the desired alignment when rigging up.

HOW TO—Guide Sand Line When Spooling Up



Many serious accidents have resulted from manual guiding the sand line onto the reel turning at high speeds. These accidents were caused by the close proximity of the worker to the moving reel and wire line. This hazard has been eliminated by a simple sand line guiding device fabricated in the field. Through its installation, two men are required to operate the sand reel. One man controls the unit, while the second, stationed on the opposite side of the reel, guides the sand line as it is spooled.

The device which makes this operation safe, as well as eases the job considerably over the manual method, is illustrated. It consists essentially of two rollers mounted on a framework that

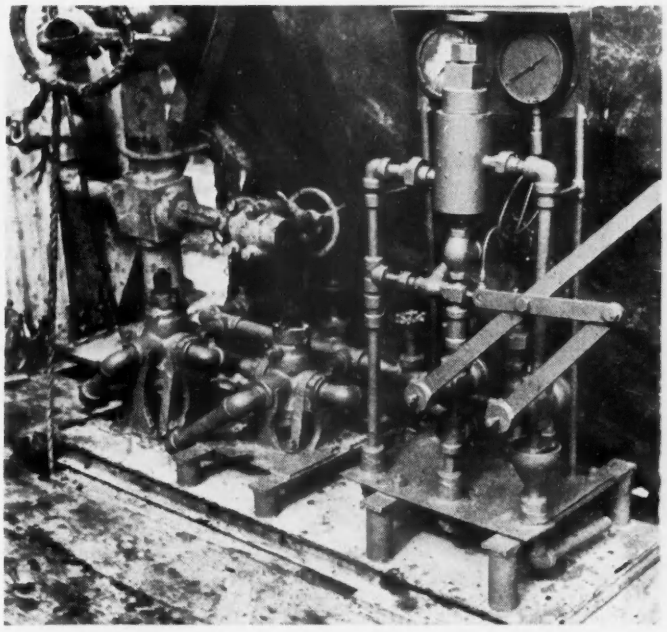
slides back and forth across the sand reel.

Flat steel plate cut in strips provided the framework for the guiding device. This framework was welded to the sand reel cover as shown. Two pieces of ¾-inch bar steel form the runners that span the reel opening, these being bolted to the framework at each end.

Flat rectangular pieces of plate steel are welded to short sections of 1-inch pipe that ride on the steel bars. Two short pieces of the bar steel are bolted at either end to the sliding elements, thereby joining these two sliding sections together.

A boxlike bracket of flat plate steel was shaped and drilled to pass through the two bar segments of the sliding guide. Two solid steel rollers are held in position on the steel bars by this bracket as shown. Such an arrangement makes it possible for the rollers to move up and down as well as sidewise across the reel. A shovel-type handle was added to permit one operator to stand at the side of the sand reel and guide the sand line as it was spooled in.

HOW TO—Mount Blowout Preventer Controls



The importance of blowout preventers in deep drilling has been emphasized even on medium-depth rigs. Method of controlling their operation has advanced from the complicated, multi-valve unit to the single valve control of modern blowout control equipment. In deep wells, particularly those in known high-pressure areas, some operators make it a practice of employing three preventers rather than the accepted two.

The installation illustrated shows how one operator unitized his blowout preventer controls for maximum efficiency and quick operation. The control valves shown actuate the opening and closing mechanism on two different types of blowout preventers and the mud line gate valve. The two valves at the far left are four-way plug valves permitting inlet and outlet of the control fluid. The valves at right are one-way flow valves, one for pressurizing the closing mechanism and the other for releasing the pressure fluids. These valves are so arranged that when one closes, the other opens.

Unique in this particular installation is the method of mounting the control valves. Supporting arms cut from one-half-inch plate steel have brackets in which the four-way valves rest. The supports have been bolted to a sheet of metal plate which forms the top of a light-weight skid. The center valve is slightly elevated above the far left valve to permit free operation of the valve stem wrench. The control unit at far right has been elevated on short pipe nipple pedestals to permit running piping into the valves. This method of unitizing the blowout preventer control valves is simple and light in weight, yet it adequately serves its purpose in providing a quick means of opening or closing any one or all three of the preventers.

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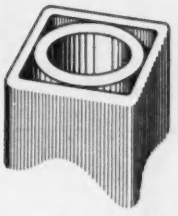

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Size	Overall Length	Bottom Connection	Top Connection	Size Opening
2½"	18½ ft. 21½ ft. 23½ ft.	2" A.P.I.—8 Rd. Thd. Upset	3½" L.H. 8 Rd. Thd. Int. Upset Drill Pipe	1⅛"
3"	21½ ft. 23½ ft. 26½ ft. 36 ft.	2½" A.P.I.—8 Rd. Thd. Upset	3½" L.H. 8 Rd. Thd. Int. Upset Drill Pipe	1¾"

For full information see 1948 Composite Catalog, page 1524, or write to

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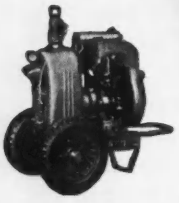
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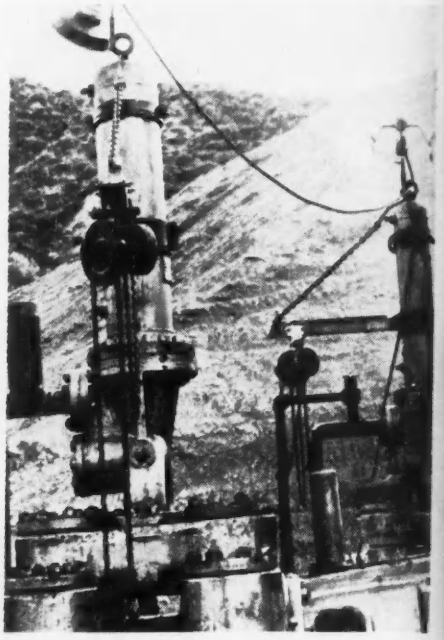
HOW TO— Provide Chain Hoist on Mud Pumps

When repairing mud pumps by replacing valves in the ports, the use of a large hammer and a crowbar is largely eliminated when each unit is equipped with a chain hoist and swinging trolley track. The structural steel member from which the track is formed is of sufficient length to place the trolley and chain hoist supporting hook directly above any part most distant from the center of the pump section where lifting is anticipated.



Anchor for the track is at the air chamber of the mud pump where a heavy ring is attached at the desired height above the bedplate of the pump so there will be an adequate space above the valve covers to operate the chain hoist. As this ring is clamped solidly to the air chamber, it becomes a base for the anchor of the track which in turn is securely attached to the air chamber with a supporting ring adjusted so that it will rotate easily and without binding.

A diagonal brace, made by using eyebolts and steel chain, supports the outer end of the track and maintains a comparatively level position when loaded at the extreme end. The trolley is a standard unit with an eye-bolt so the chain hoist can readily be attached with the hook at the top of the wheel cage. While not advisable to lift heavy weights due to loading of the air chamber, the hoisting device acts as a safety precaution for the crew in making pump repairs which require lifting objects that are heavy for one man. Too great a strain on the hoist will cause the flange on the air chamber to become loosened and prevent the chamber from functioning properly.

HOW TO— Make Rig Utility Post

An "immovable object" on the floor of a drilling rig is always necessary for the many different operations that must be performed. A backup post is common scenery around the drilling rig, but here is an extra strong unit that performs many useful jobs. Not only does it provide anchorage for the backup tongs, but it also serves as a point at which blocks may be stationed when positioning heavy objects on the floor with the cathead. Heavy-duty eyes are located

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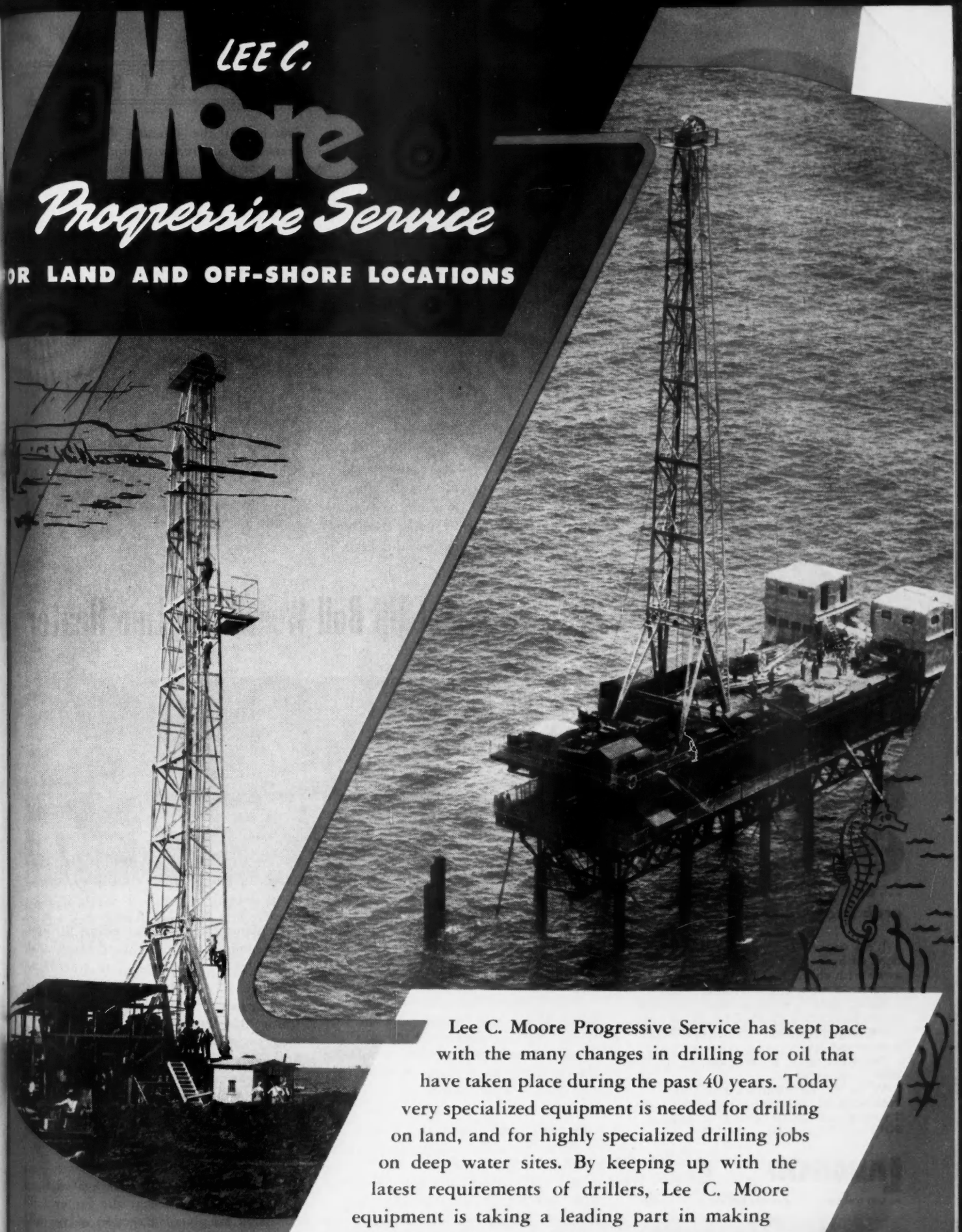

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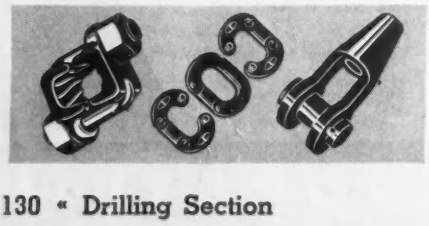
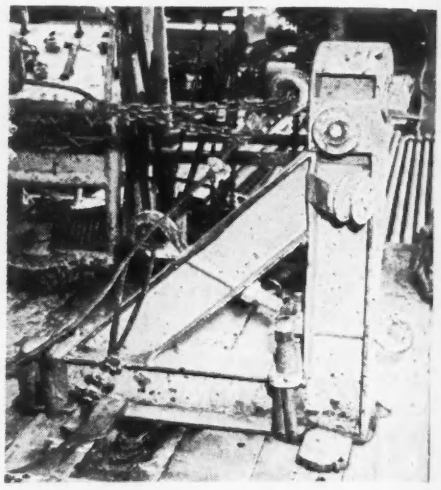


on the device which facilitate much of the heavy winching jobs on the derrick floor.

A special feature not found on many backup posts is the built-in pulley system shown. The lower steel pulley is mounted on an angle bracket so that it is in line with the cathead on the drawworks. Immediately above it is a second such pulley mounted so that it faces the rotary. Such an arrangement makes it possible to get a catline pull which is 90 degrees from the well to cathead pull. It is useful in breaking out drill collars, bits, etc.

The post is made from six-inch I-beam structural steel and is anchored to the floor with heavy U-bolts which fit around a member of the substructure. It is equipped with adequate footing so that the floor boards will not be crushed under extremely heavy pulls. The horizontal member resting on the floor is rounded at the juncture of the angle brace and covered with thin metal plate to protect personnel working on the floor who may accidentally kick the beam.



HOW TO— Set Up Boll Weevil Gas Line Heater

In the early life of an oil or gas field, fuel for the drilling rig boilers must be obtained as and how the operator can get it. After the first well has been completed, usually enough gas is produced to furnish fuel for the rigs operating in the field.

Where this field gas system pressure is relatively high and must be reduced by a regulator to bring it down to burner pressure, it sometimes happens that the gas contains sufficient hydrates to cause some freezing at the regulator, particularly in cold weather. In the case shown, the gas required only a slight amount of heating to prevent trouble at the regulator, and a "boll weevil" heater was quickly constructed and placed in the line.

However, the unit contains several features which are well to mention for the benefit of those who must make similar installations in new fields of this type. The field system consisted of two-inch high-pressure pipe. The heater was simply a long section of 14-inch casing which had been closed off at both ends with the exception of a packing element that permitted a length of two-inch pipe to be inserted through its entire length with about 18 inches extending through either end. These ends were fitted with unions that connected into the field system.

The heater was mounted on pipe frame supports and so located that a long reverse bend was necessary in the line. This bend acted to compensate for any expansion or contraction in the line due to temperature changes. A shop-made packing element was incorporated at each end where the gas line entered the heater. The annulus between the gas line and the outside casing was filled with water which was heated by a small fire box shown at the far end. It consisted simply of a section of vertical pipe which was welded to the casing, with a small burner inserted inside. Only a small portion of the casing section was heated, but this was sufficient to do the job.

HOW TO—
Brace Removable Post

When the pipe racks are designed for speed and efficiency when either tearing down or rigging up at a well, a section can be made to fit at the end of the walk to load or unload tools and to contain the tail post for the derrick high line. Since the trolley on the high line carries heavy material, such as drill collars, the drill pipe and kelly when laying down, it can be made to do high speed work when the tail post is built for quick dismounting and mounting.

If the tail post is made of four-inch

drill pipe, the socket, or rathole, can be made of the next larger size so the tail pipe can be inserted, or withdrawn as desired for rigging up or tearing down. The lower end of the rathole, or socket, is securely welded on the derrick side of a substantial cross member connecting the risers, or legs of the walk section built to handle the tail post. A similar cross member provides support at the top of the walkway section, but the socket, or rathole, is placed on the outside so it will be substantially braced at both top and bottom.

A diagonal brace from a forward cross member of the walkway section is attached to the top of the socket, while a second brace, but shorter is tied into the bottom cross member and at about the half-way point of the first brace. Holes matching in both the tail post and the socket are bored so that a variable height of the tail post can be obtained by sliding it up or down before locking with the securing pin.

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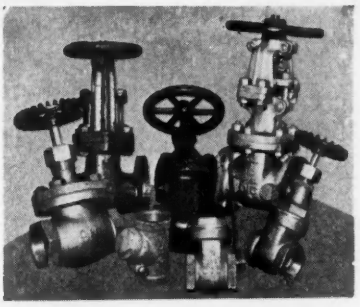

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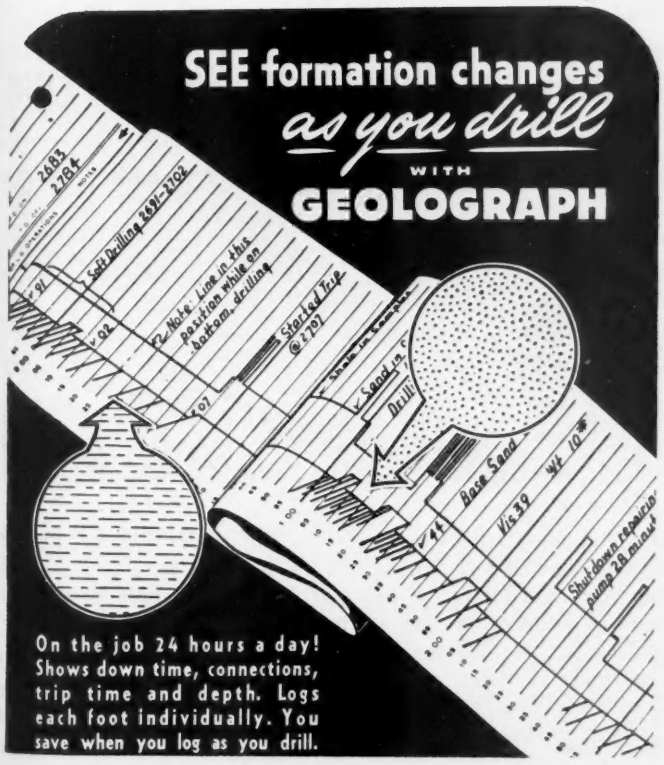

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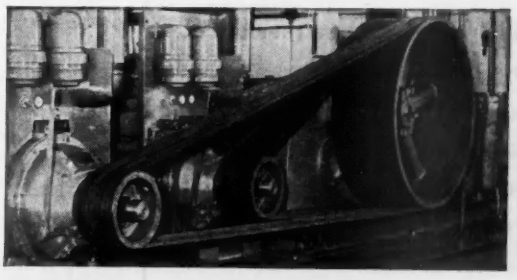

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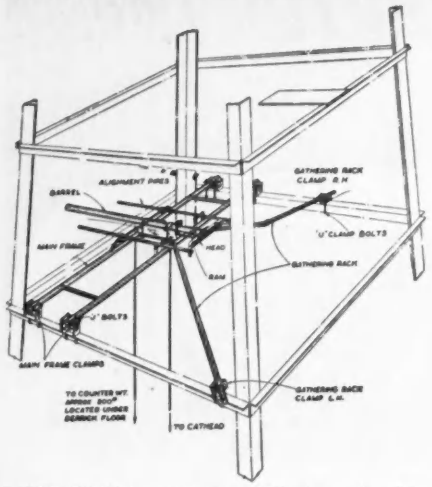

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haust muffler can be extended outward from the area to dissipate the gases of combustion.

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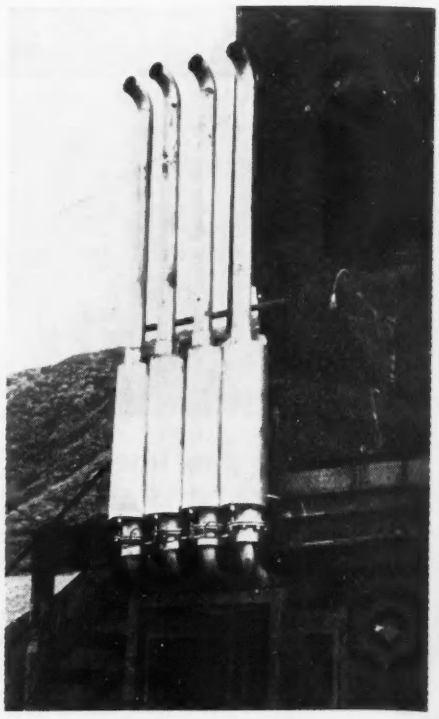
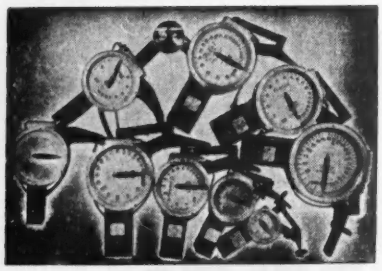
The four mufflers are installed on a common bracket which in turn is bolted to the structural steel sill, with an additional steady-rest obtained by attaching the base of each tail pipe with clips to the top rail of the safety guard.

Bolted couplings between the base of the mufflers and the exhaust pipes are used so the group of mufflers can be removed as a unit. As a precaution to guard against the weight of the mufflers being placed on the engine manifolds, a rectangular frame, made of light angle iron, is set beneath the exhaust pipes near the ends which are attached to the muffler connections.





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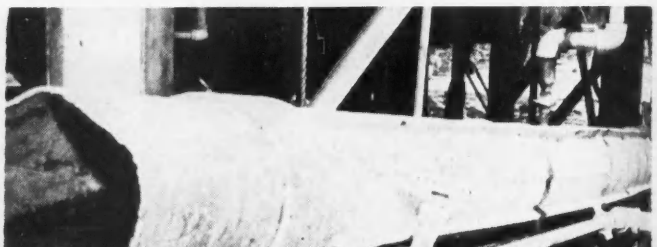
HOW TO— Reinforce Shop-Made Return Line



One of the most roughly treated pieces of equipment on the rig is the mud return line. This line cannot be very well protected during rig moves and is subject to heavy blows from other equipment which tend to bend it. The mud return line illustrated was made in the shop from thin plate steel at a time when casing and pipe of any kind was at a premium. The steel plate, about four feet wide, was rolled and welded, with each section butt welded to the next so that the stringer beads on the longitudinal welds offset each other.

Being somewhat lighter than the normal casing-type mud return line, some means of protection had to be added to the line shown. The flow line had been fabricated to a standard length for this particular rig, and the open end terminated with a pipe collar. Any variations in rig setup between locations which would place the shale shaker further from the well than normal could be handled by adding a nipple to the line as shown.

Four equally-spaced strips of steel reinforcing bars were welded to the line as shown. Not only do these reinforcing strips provide added strength to the flow line, but they aid in loading the unit onto trucks. The steel strips prevent the line from rolling on the truck bed. While somewhat of an emergency measure, this mud return line made from available thin steel plate has served satisfactorily.

Mechanical Removal of Free Water from High-Pressure Gas Lines to Prevent Formation of Hydrates

By ARTHUR F. BARRY
Production Superintendent, The Superior Oil Company of California

ONE OF the most distressing problems to the production engineer in fields producing gas-condensate at high pressures is that of hydrate formation and subsequent plugging of pipe lines. Recognized procedures for combatting this situation at Superior's Lake Creek field were employed with the result that one of the large gathering lines was plugged for approximately 20 percent of the winter periods. An economic and efficient solution to this problem was developed with the cooperation of Asbury Parks, consulting engineer, who designed the equipment. The procedures followed, data collected, and results obtained are authoritatively discussed.

THE gathering of gas and condensate at high pressures for extraction, cycling and gas lift purposes has presented the industry with the problem of hydrate formation in individual flow lines from the well head to the extraction plant or separator. This problem becomes more complex and serious as field gathering pressures increased since hydrate expectancy temperatures increase with pressure.

In order to prevent hydrate formation or freezing, the water present in the gas and condensate must be removed from the flow stream, or flowing temperatures must be maintained above hydrate temperatures. If the latter method is to be employed, the flow stream is ordinarily heated with indirect water heaters. To depress the dew point by removing water from the gas and condensate, dehydrators are employed. The initial cost and maintenance of dehydrators often prohibit their use for individual well flow lines. Indirect water heaters are costly from a fuel standpoint, and without proper insulation the heat transferred to the flow stream by them is lost in short distances down the line.

Blocked Line

Hydrate formation in a gathering line from three gas-condensate wells in the Lake Creek field of Montgomery County, Texas, caused the line to be "frozen up" about 20 percent of the time during the winter of 1947-1948. The gathering line, operating at 1800 pounds per square inch pressure, was 6 5/8-inch outside diameter and weighed 62.03 pounds per foot. It delivered an average of 7 million cubic feet of gas per day to the cycling plant. The average velocity of gas flow was quite low, 5.9 feet per second, and water accumulated in low points along the line.

Under conditions in the line, hydrates began to form at 70° F. and because considerable amounts of free water were present, an ice plug accumulated in a period of 24 hours, blocking the line. No freezing occurred in the lateral lines shown in Figure 1, since indirect heaters were originally installed with sufficient heating capacity to mantain temperatures above hydrate expectancy temperatures up to the main gathering line. Ice plugs in the 6 5/8-inch gathering line were removed by blowing the gas and condensate to the atmosphere, thereby reducing the pressure. This procedure was costly, since the gas and condensate were a total loss.

Indirect heaters with capacities of 500,000 British thermal units per hour were installed at 6000-foot intervals on the main gathering line, which was insulated and supported above ground level. Heaters installed in this manner failed to maintain flow temperatures high enough in the winter months to prevent freezing. Heat input into the gas flow was dissipated through the line between heater installations.

Knockout Installed

Under the assumption that the removal of free water would prolong the time for the formation of sufficient hydrates to plug the line, a free water knockout shown in Figures 2 and 3 was installed 300 feet downstream from the lateral lines illustrated in Figure 1. Individual well tests indicated that 6300 pounds of free water accumulated daily in the line. The calculated water content of the saturated gas at separator conditions of 75° F. and 1800 pounds per square inch was 18.75 pounds of water per million cubic feet of gas, or 131 pounds daily. Assuming a maximum temperature drop of 40 degrees Fahrenheit (75 degrees to 35 degrees) in the line, a total of 103 pounds of free water would accumulate daily in the line. By comparing the total free water before separation (6300 pounds) to the free water after separation (103 pounds), it was concluded that the free water knockout would probably prolong the formation of sufficient hydrates to plug the line for 61 days, provided the temperatures during that time were low enough for hydrate formation.

Since winters in the Gulf Coast area do not ordinarily provide these temperatures for 61 consecutive days, the installation seemed justified. The indirect heaters previously installed on the main

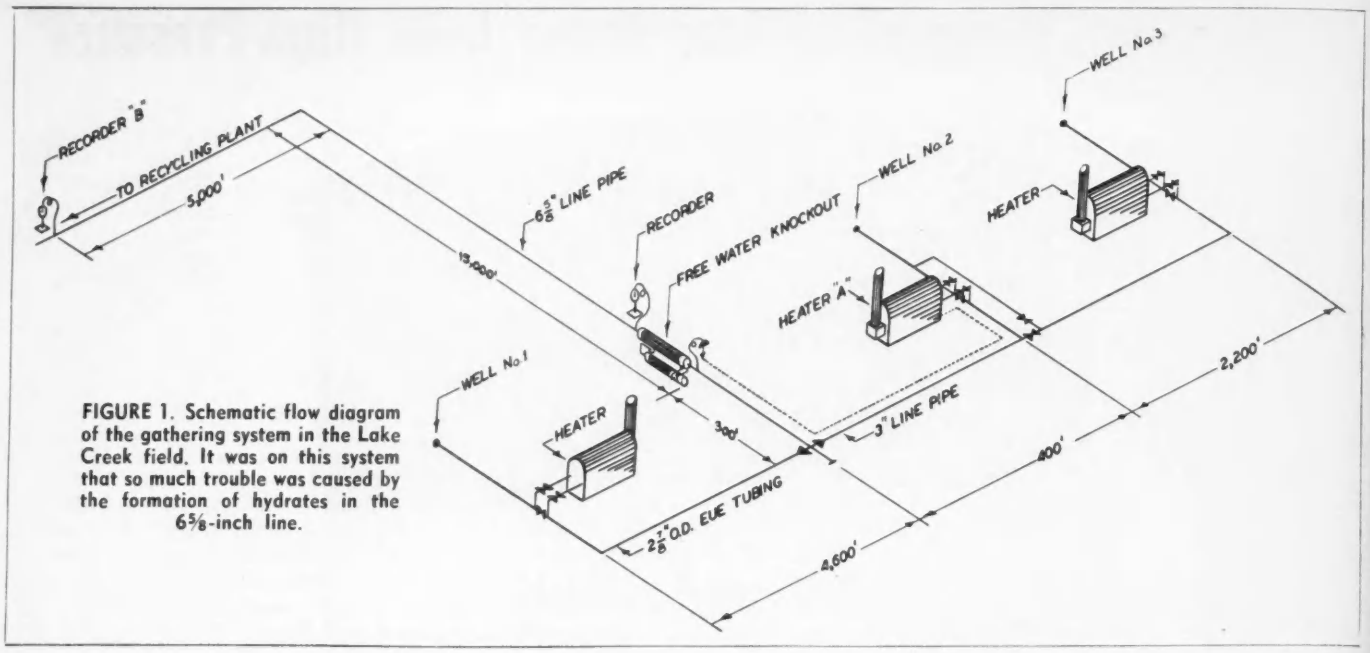


FIGURE 1. Schematic flow diagram of the gathering system in the Lake Creek field. It was on this system that so much trouble was caused by the formation of hydrates in the 6⅝-inch line.

gathering line were used downstream from the knockout for a period of 30 days prior to the winter months in order that previous accumulations of water could be removed. The indirect heaters were taken out of service during the first period of cold weather and remained out during the entire winter of 1948-1949.

A temperature controller was installed immediately upstream from the water knockout to maintain a temperature of 75° F. in the lateral lines. This temperature is just five degrees above hydrate expectancy, and was maintained at this point by controlling the fuel supply to heater "A", shown in Figure 1. A temperature recorder was installed on the knockout and the operating temperatures recorded as shown in Figure 5. The temperature at the terminal of the line, point "B" in Figure 1, was recorded and these results are also shown in Figure 5 as Curve No. 2.

The water knockout, shown in Figures 2 and 3, was housed in a concrete box to prevent high water from flooding the controls. A general view of the field installation on this particular line in the Lake Creek field is shown in Figure 4. During periods of high water, the land is covered with several feet of water, many times necessitating the use of boats by the maintenance crews.

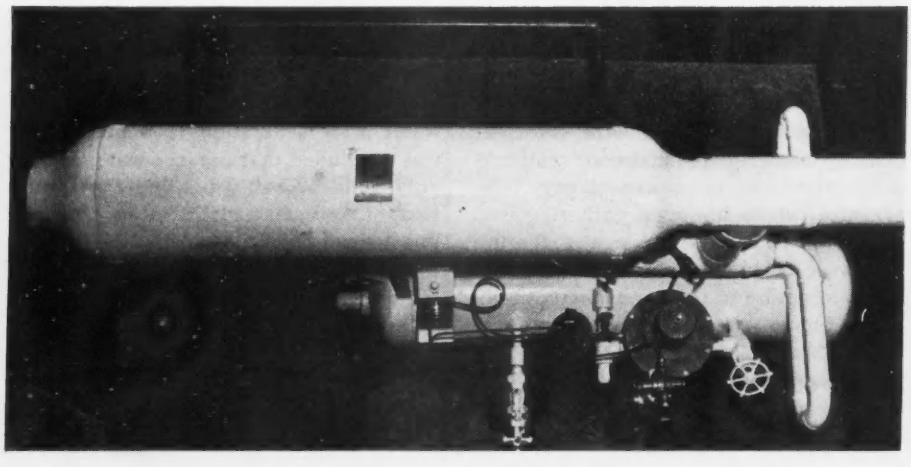
It is apparent from Curve No. 2 in Figure 5 that line temperatures were considerably below hydrate expectancy temperatures. A temperature of 35° F. was recorded in the line at recorder "B" during the latter part of January. The gathering system was in operation during the entire winter of 1948-1949 without freezing occurring to plug up the line. A series of dew points taken by the Bureau of Mines method at point "B" of Figure 1 are shown in Table 1. The water content of the gas at the knockout was determined from the temperature and pressure, assuming the gas to be saturated. Neglecting water that may be present in emulsion form in the condensate, the water accumulation in the line was the difference between water saturation at the knockout and water saturation at point "B."

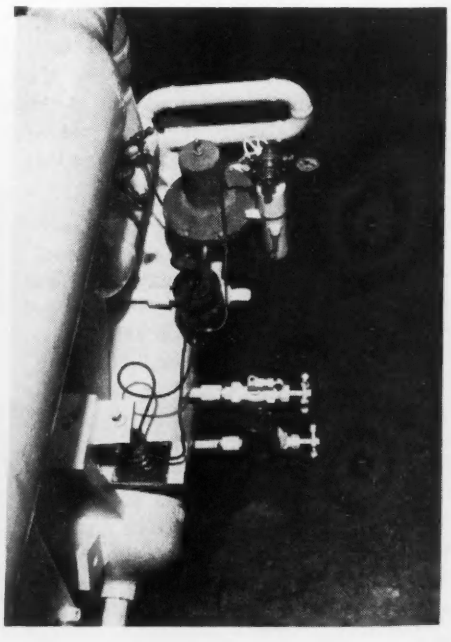
Obviously, the ideal water knockout operating temperature would be the lowest temperature at which no freezing would take place in the separator or upstream from the separator. For several short periods during January and February, 1949, the separator was operated at temperatures below 70° F. and no freezing was noted.

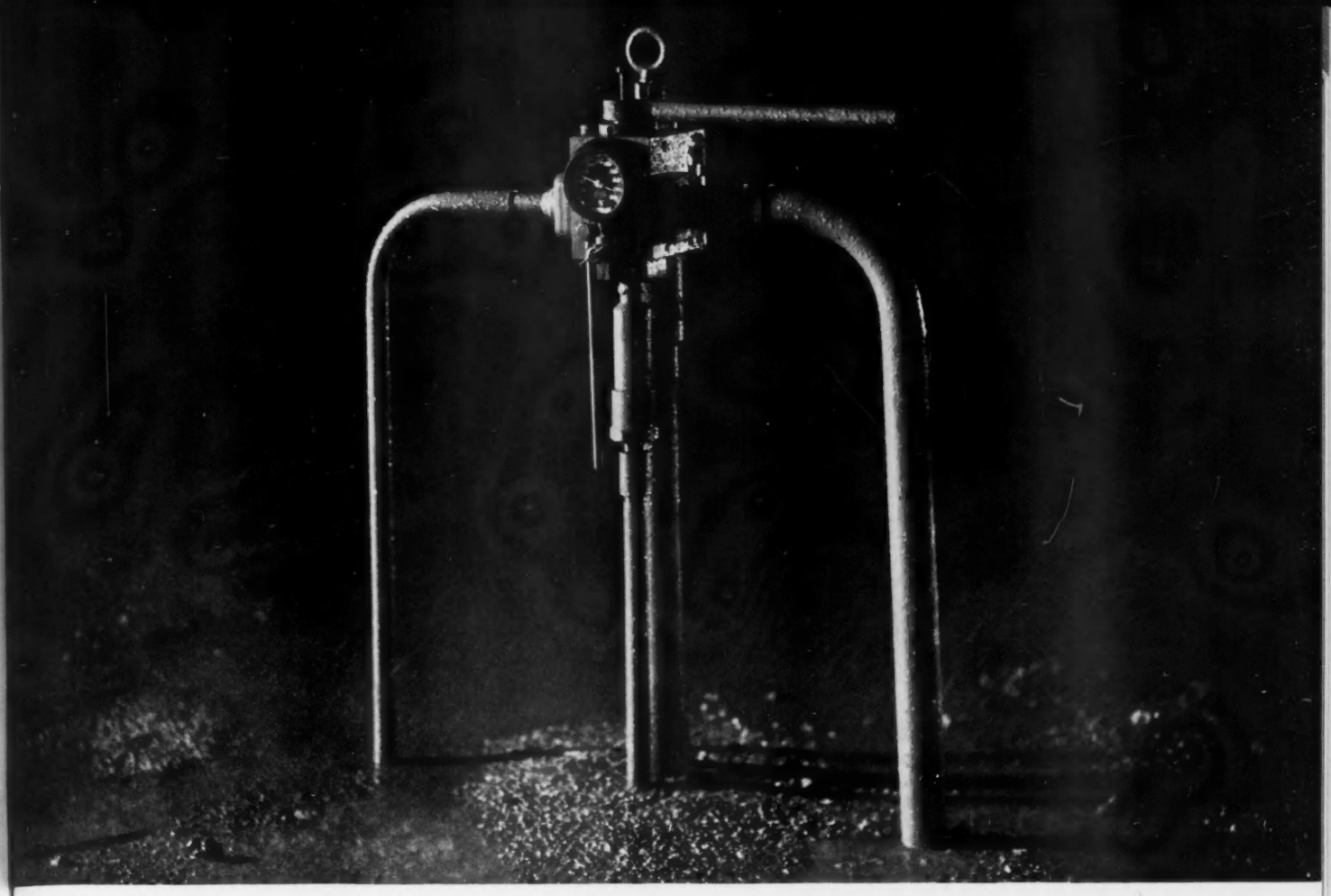
Turbulence, sufficient water and low temperatures are necessary for the for-

FIGURE 2. (Left) Top view of the water knockout device that proved so effective in removing free water from the flow stream of gas-condensate in the gathering system.

FIGURE 3 (Right) Close up of the control regulators and lower fluid vessel. By means of the gauge glass at lower right, liquid interface level in the lower vessel can be accurately controlled by the strain gauge pilot shown near the bottom of the photo.







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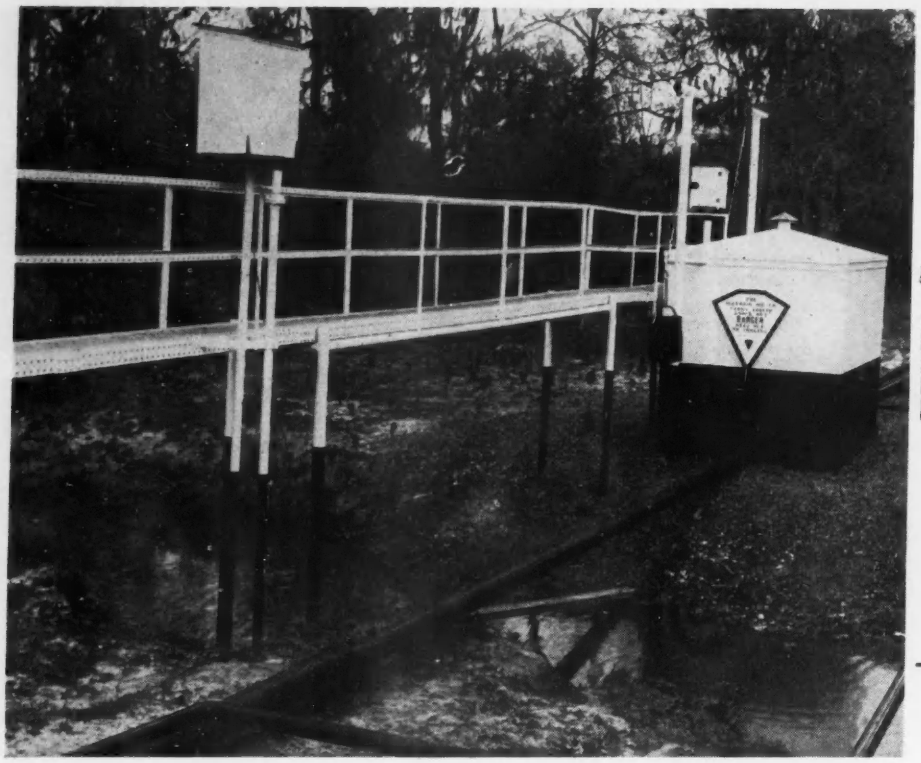


FIGURE 4. It was necessary to enclose the water knockout device inside this concrete casement to prevent flood waters from submerging the control mechanism during periods of high water. The gathering line runs through the casement at ground level.

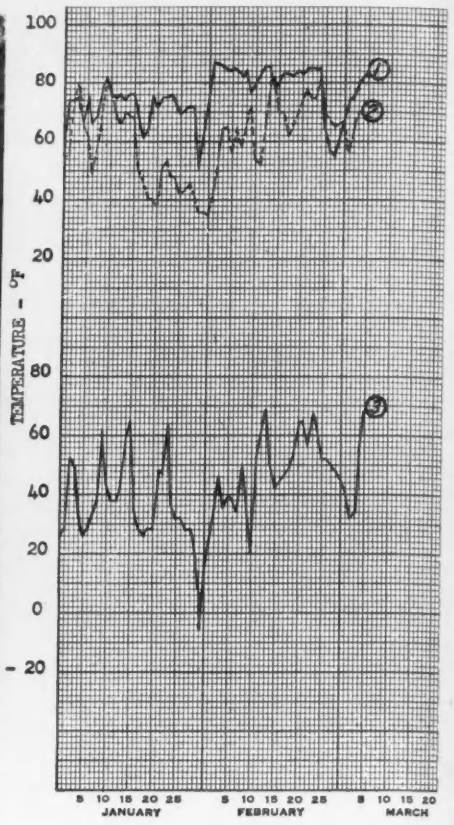


FIGURE 5. Minimum daily temperature vs. time. Curve 1: Operating temperature at water knockout. Curve 2: Temperatures at Point 'B.' Curve 3: Atmospheric temperature.

mation of hydrates in high-pressure gas lines. Stream line flow was maintained throughout the winter months in this particular gathering system, and there were no abnormal pressure drops. Table 1 reveals that sufficient water was present for gas saturation. Since temperatures of 35 degrees below hydrate expectancy temperature were recorded in the flow stream, it seems probable that sufficient water was not present for hydrate formation, or sufficient hydrates were not formed to plug the line.

It can definitely be stated from the data submitted in this article that the removal of free water together with laminar flow conditions, free from shock, eliminated the freezing conditions experienced during previous winters.

Location of a free water knockout installation should be such that the flow stream can be cooled sufficiently before water separation. The knockout used on this installation is shown in Figures 2 and 3, and a diagrammatic sketch of the unit is shown in Figure 6. The flow stream of gas condensate is directed through scrubber section "A" in Figure 6. Gas and liquid are separated in the upper chamber, and the baffle or weir on the downstream end of the upper chamber allows the gas to flow through line "B" while the liquid accumulates in the lower chamber through line "C."

Liquid then rises to point "D" and is recombined with the gas stream and directed back into the gathering line. In this manner, any condensate floating on the free water will go back into the line. Free water is released through valve (1). The liquid level, or the interface between the condensate and free water, is controlled by the mechanism shown schematically in Figure 6. One end of the lower chamber is fixed by the piping arrangement, and the other end rests on a strain gauge pilot (5). Any increase in weight due to the accumulation of liquid transfers a force on the strain gauge pilot with infinitesimal movement of the lower chamber. The entire lower lessel may be compared to the float in a conventional separator. The strain gauge pilot controls the flow of gas to a snapper valve (3). As the weight in the lower vessel increases, the strain gauge pilot increases the pressure on the snapper valve up to a predetermined pressure.

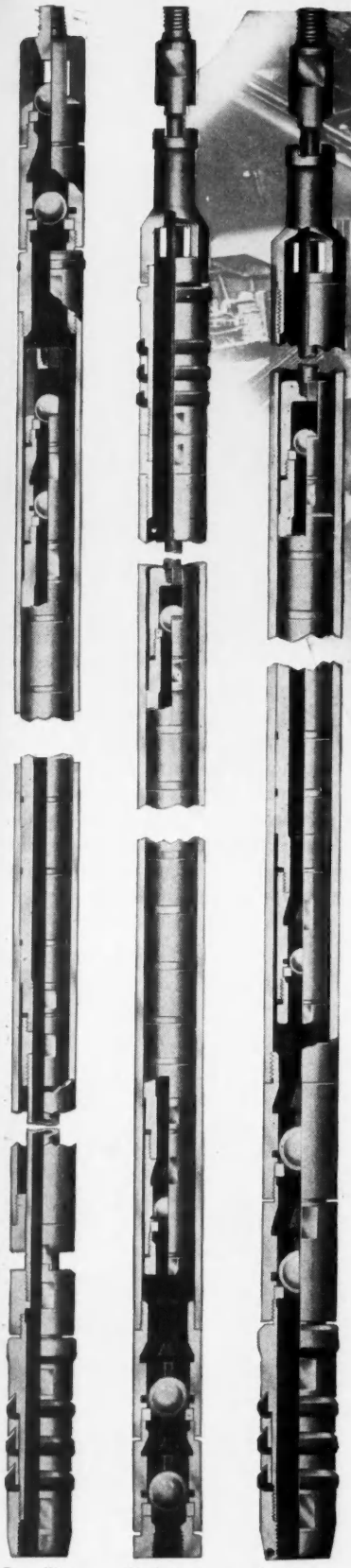
When this predetermined pressure on the snapper valve is reached, the valve opens, allowing a supply of gas to flow to the diaphragm-operated dump valve (1), and the valve opens. As the liquid is discharged, the vessel becomes lighter, the strain gauge pilot closes, causing the pressure to be released on the snapper valve and dump valve, and the dump valve closes. With the exception of the small volume of gas released in operating the snap-acting dump valve, there is no supply gas vented in the control system.

Controlling Interface Level

The operating interface level is controlled by adjusting the strain gauge. A water-condensate or a condensate-gas interface level can be controlled with the strain gauge. Gas used for the pilot supply is reduced from the operating pressure of the knockout (1800 pounds per square inch in this installation) to 30 pounds per square inch. The major pressure reduction is accomplished by regulator (2) in Figure 5, which reduces the pressure from 1800 to 100

Table 1

FLOW DATA AT WATER KNOCKOUT			FLOW DATA AT POINT "B"				
Flow Temperature °F.	Flow Pressure, Psig.	H_2O Saturation Pounds per Million Cu. Ft.	Flow Temperature °F.	Flow Pressure Psig.	Dew Point °F.	H_2O Saturation Pounds per Million Cu. Ft.	Water Accumulation in Line Pounds per Million Cu. Ft.
76	1705	20.0	48	1680	46	8.0	12.0
77	1725	21.0	41	1655	39	6.5	14.5
99	1750	39.0	67	1720	67	15.5	23.5
95	1825	34.0	79	1800	79	22.0	12.0
88	1825	27.0	60	1805	60	12.5	14.5
92	1810	31.0	83	1790	80	22.0	9.0



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pounds per square inch. The pressure is further reduced from 100 to 30 pounds per square inch by regulator (4).

The stem and seat of regulator (2) is in the flow stream and therefore the reduction in pressure or gas expansion takes place at separator temperature. Since the pilot supply gas volumes are so small, expansion is accomplished without any appreciable loss in temperature. With the separator operating at 1800 pounds per square inch and 75° F. and with no appreciable temperature drop due to expansion, the dew point of the supply gas is below ten degrees at 30 pounds per square inch. No freezing occurred in the pilot system throughout the winter months, and no water accumulated in the drip pot of the control system.

At constant temperature, the water content of saturated gas decreases with increased pressure. Maximum free water recovery will be obtained by operating the water knockout at well pressure. Since the accumulation of small volumes of free water, shown in Table 1, in the gathering line downstream from the knockout failed to produce sufficient hydrates to plug the line, even though the temperatures were considerably below hydrate temperatures, it seems reasonable to conclude that the minimum operating temperature for maximum water recovery would be considerably below the hydrate temperature. The time intervals during which the free water knockout was operated at temperatures below hydrate temperatures are too short to draw definite conclusions. However, by inclining the upstream line down to the separator to prevent excessive accumulation of free water prior to separation, these low free water knockout operating temperatures could probably be maintained for long intervals without freezing. If it were possible to operate the separator at temperatures below ground temperatures and no water in emulsion were present in the condensate, the gas in a buried flow line would be undersaturated when warmed to earth temperature and would not result in the formation of hydrates.

About the Author

ARTHUR F. BARRY, a native of Louisiana, was made production superintendent of The Superior Oil Company of California in 1947. From the company's headquarters office at the Lake Creek field, he supervises Superior's production activities from southwest Arkansas to West Texas, throughout the Texas Gulf Coast down to the Lopez field, and north to Wichita Falls. He went to Lake Creek as district petroleum engineer in 1942 shortly after discovery of the field, and has been concerned with the production and transmission of high-pressure gas-condensate ever since. A graduate petroleum engineer from Louisiana State University in 1939, Barry started with Superior that year as a roustabout in the Bosco field. Since that time, he has had experience in practically every phase of oil and gas production.

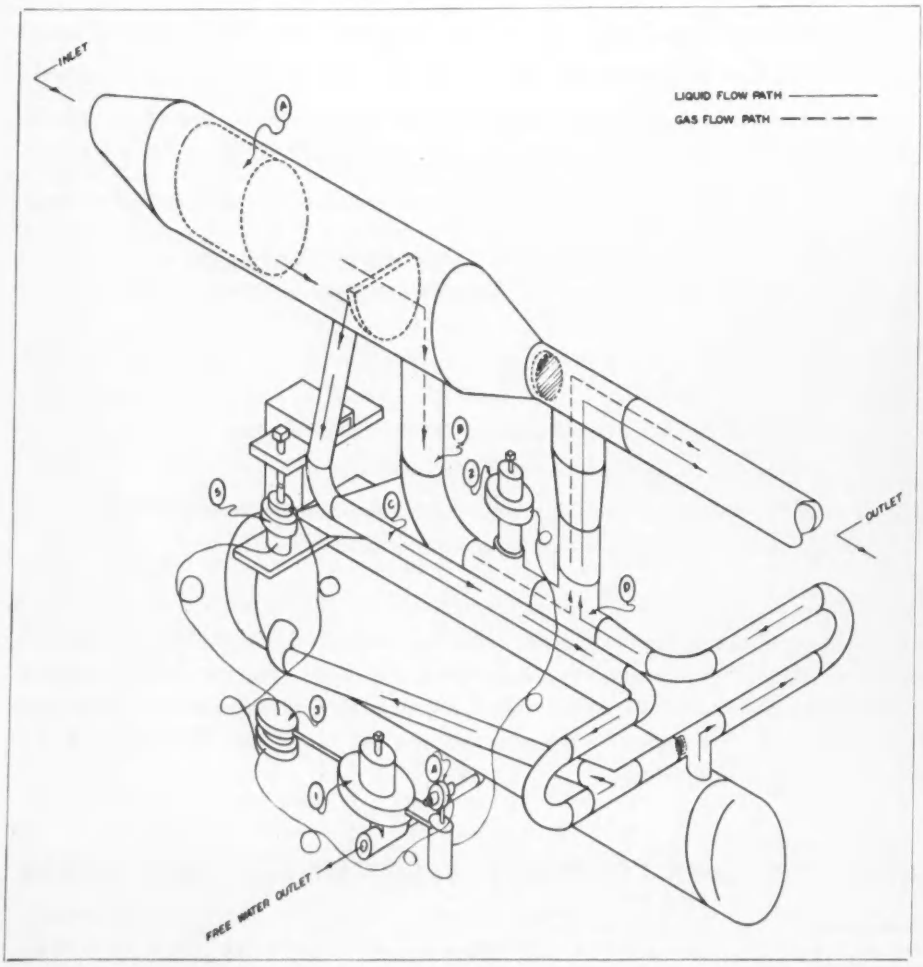

FIGURE 6. Schematic diagram of water knockout device. The cross-hatched discs indicate where the line has been blanked off. The equipment normally operates at an average pressure of 1800 pounds per square inch, but was tested at 6000 pounds per square inch.

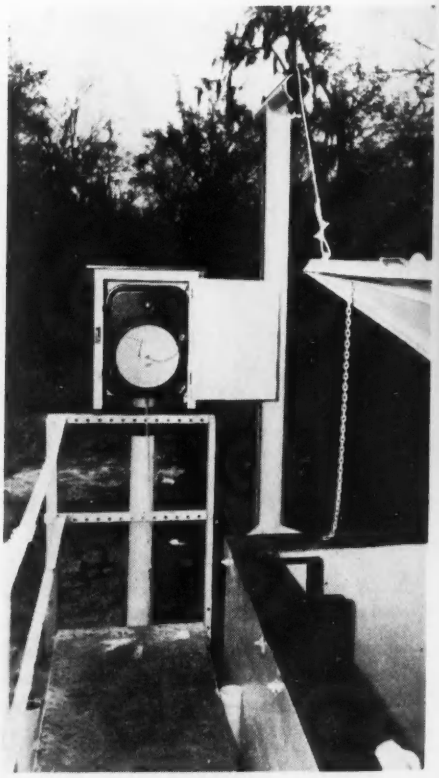

FIGURE 7. Pressure recorder on the water dump line. A continuous chart recorded each time the water knockout dumped. Such excellent records were obtained that it was almost possible to calculate the gas production from these charts.

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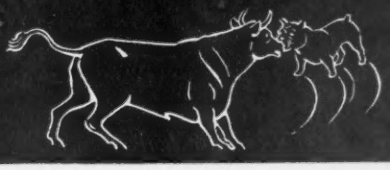

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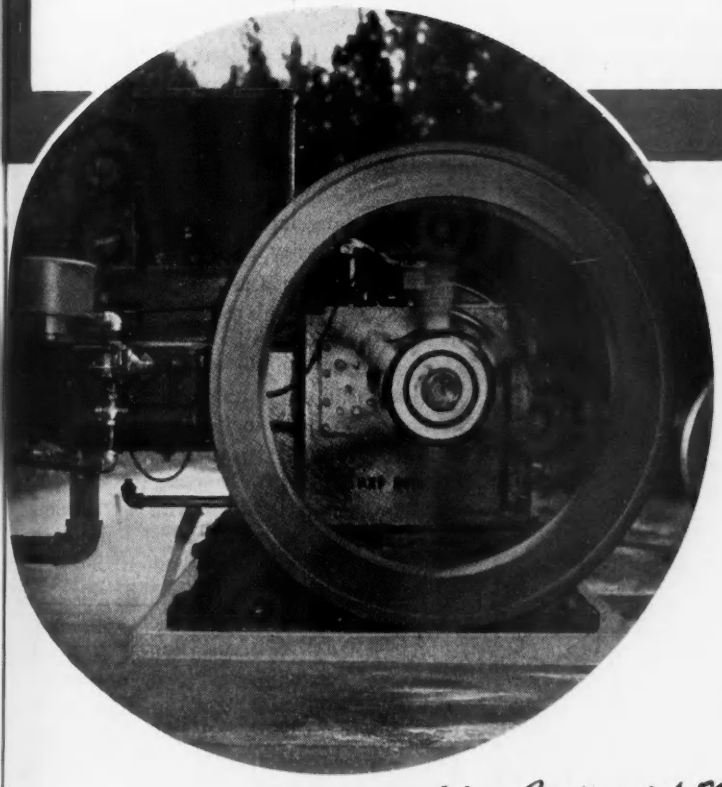

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Factors Affecting Production by

Air-Gas Drive

By R. F. NIELSEN and D. E. MENZIE
Division of Petroleum and Natural Gas Engineering,
The Pennsylvania State College

FACTORS affecting the recovery of oil by secondary recovery methods have been the subjects of numerous laboratory and theoretical investigations. Some of these factors, such as the nature of the sand and of the fluids originally contained therein, are beyond the control of the operator. Other factors, such as the pressures applied or the nature of the driving medium, can be varied at the discretion of the operator.

In speaking of the amount or efficiency of recovery, the operator is interested in three things: how much oil can be obtained; how long it will take to get it; and, what it will cost.

In order to predict these things, laboratory investigations must, more often than not, involve materials and methods that could not, possibly be used in the field. This is necessary in order to determine quantitatively the separate contributions of the individual variables, as well as to help in arriving at an understanding of the processes occurring in the sand. Hence, one resorts to experiments with specially prepared sands and fluids, performed under idealized conditions, and the determination or calculation of limiting or theoretical quantities.

IN ORDER to evaluate separately the contributions of individual factors or variables toward production by air-gas drive, certain types of idealized laboratory experiments are necessary. Among the variables affecting the production history of an air drive are the viscosities of the fluids and the distance from input to producing wells. Laboratory experiments with long cores are described into which these two variables enter. The data are interpreted in the light of theoretical considerations which may prove useful in predictions of field behavior. This paper was presented at the Twelfth Annual Conference on Secondary Recovery at the School of Mineral Industries of The Pennsylvania State College, State College, Pennsylvania, October 14, 15, 16, 1948.

One of the chief physical quantities entering into the recovery process is viscosity. Experiments on the effect of the viscosities of both the driving and the driven medium have long been under investigation in this and other laboratories. Unfortunately, one cannot predict all the effects of a change in viscosity by a simple proportionality, or even by any known straightforward calculation. If so, experiments with viscosity as the main variable would be unnecessary.

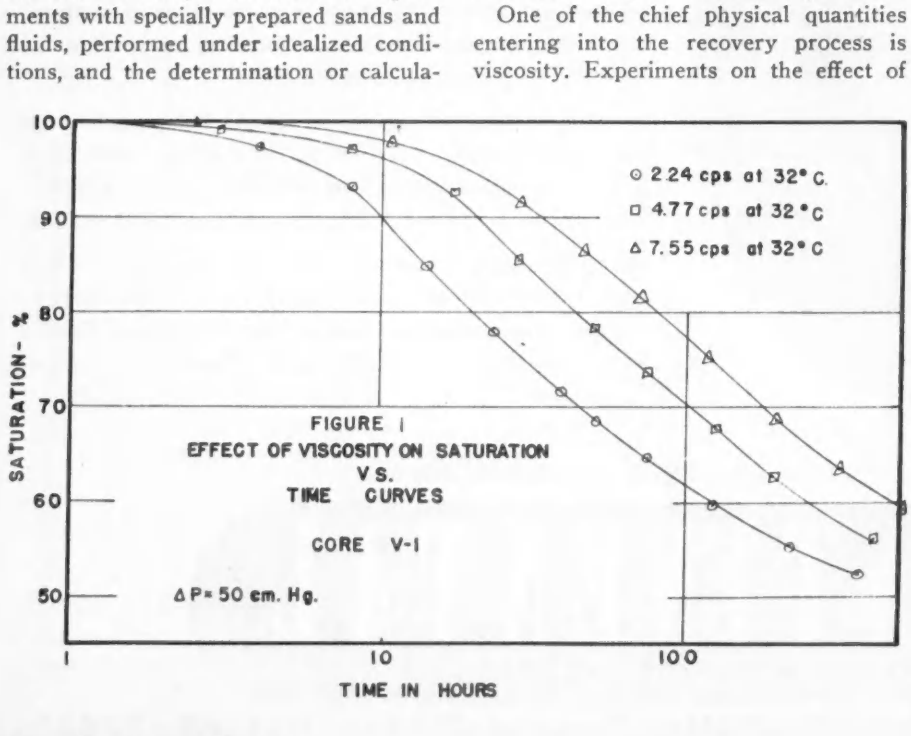


FIGURE 1
EFFECT OF VISCOSITY ON SATURATION VS. TIME CURVES
CORE V-1

Darcy's Law

Viscosity is one of the quantities in Darcy's Law. This means that, at some particular point in the sand, the rate of flow of a fluid is inversely proportional to its viscosity, the pressure gradient and permeability to that phase remaining the same. If the saturation and sand-wetting properties remain the same, it is generally believed that the permeability to the given phase remains the same. There has as yet been no definite evidence that relative permeability varies with the viscosity of the fluid.

While Darcy's Law applies at every point, the practical results of a change in viscosity of one of the fluids may not always be so readily calculated. In the case of an air drive on a long core, such as has been used in laboratory studies, all oil produced from upstream must pass a given point, so that the rate of oil flow as well as the oil saturation must increase toward the downstream end; there is a velocity gradient as well as a saturation gradient. The relation between the velocity gradient and the rate of change of saturation at a point is known as the "continuity equation," which is simply a material balance equation. The velocity gradient is related to the saturation point through Darcy's Law, since the relative permeability to oil depends upon the saturation. It is also related to the pressure gradient which in turn increases toward the downstream end because of the saturation gradient and because of the gas expansion. Toward the producing end there is the further complication that the pressure gradient is not the same

in the oil phase as in the gas phase, due to capillary effects.

Simultaneous Equation

The simultaneous equation of the continuity equation and Darcy's equation for an air drive on a long core has never been accomplished. The continuity equation for linear flow in a porous medium may be written as follows. At some one point at a given time

$$\frac{dS_o}{dt} = \frac{-1}{f} \cdot \frac{dV_o}{dx}$$

where S_o is the oil saturation expressed as a fraction, t is time in seconds, f is the porosity expressed as a fraction, V_o is the flow of oil in cubic centimeters per second per square centimeter cross-section of sand, and x is distance in centimeters measured in the direction of flow. Similar equations apply to the gas or water phases.

Before continuing with the theoretical discussion it might be well to present some recent experimental data. These involve the effect of change of viscosity of the driven medium, in this case the oil, when subject to an air drive, with no water being present. The oil in this case is also the wetting phase.

Venango Core Study

One series of studies was made on a 13 millidarcy Venango core, 43 inches long. The preparation of this core has been described previously.[1] It was saturated 100 percent with refined close-cut oil and then subjected to an air drive. Oils of viscosities 2.24, 4.77, and 7.55 centipoises at 32° C. were used in successive runs. The runs were made in a constant temperature unit at 32° C. The input pressure was 50 centimeters of mercury, and the pressure at the producing end was atmospheric. Before being passed into the core, the air was bubbled through a reservoir containing some of the same oil as that in the core, in order to cut down evaporation. The data are plotted in Figures 1-3 which show saturation versus time, gas volumes, and gas-oil ratios, respectively.

Since, in accordance with the preceding theoretical discussion, the saturation is not constant along the core, the values given in the figures represent averages over the entire core.

Another set of runs was made on a 800 md. core of the Cow Run Sand, 36 inches in length. The preparation of the core and the method of making the runs were the same as in the case of the 13 md. core. The oils, however, varied much more in viscosity than those of the previous set, being oils of 2.24 and 82.6 centipoises viscosity, respectively. Repeat runs were made with both oils,

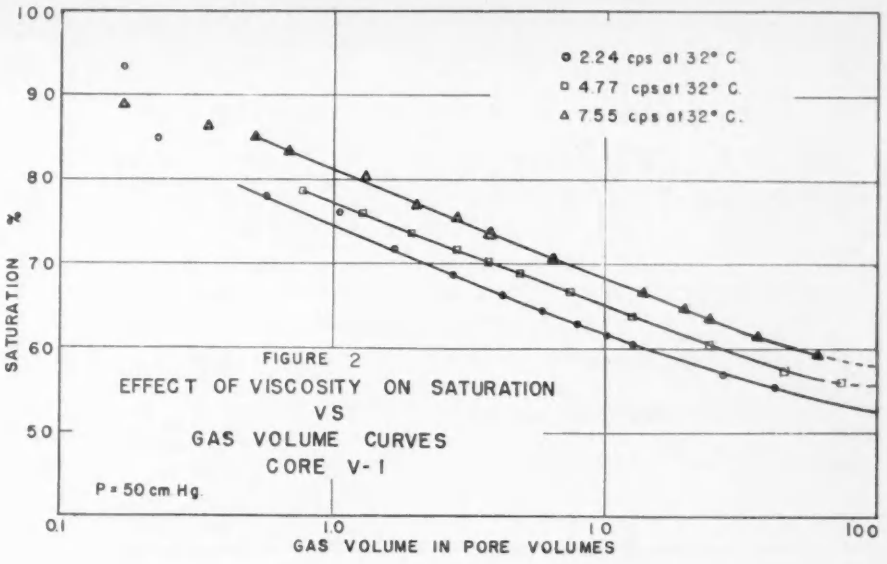


FIGURE 2
EFFECT OF VISCOSITY ON SATURATION VS GAS VOLUME CURVES
CORE V-1

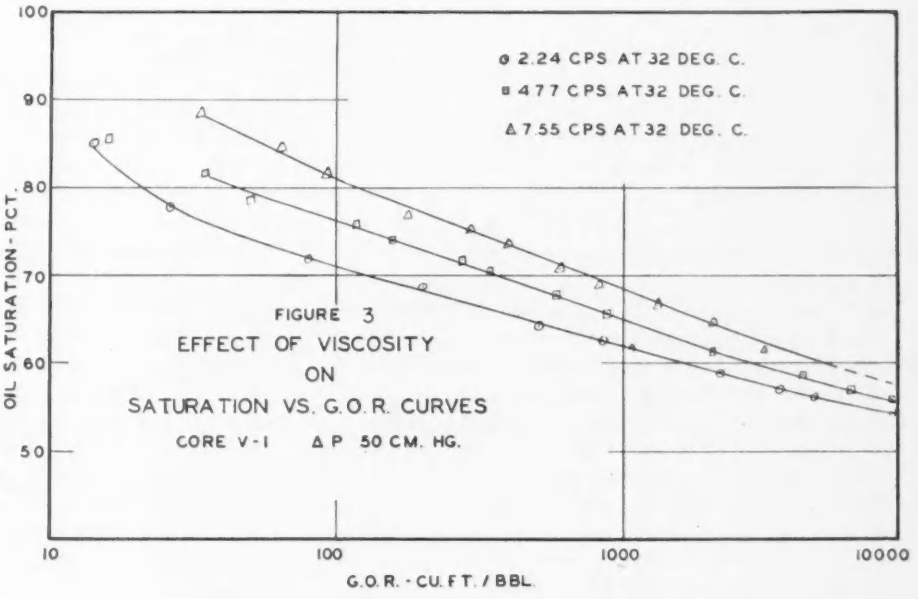


FIGURE 3
EFFECT OF VISCOSITY ON SATURATION VS. G.O.R. CURVES
CORE V-1 Δ P 50 CM. HG.

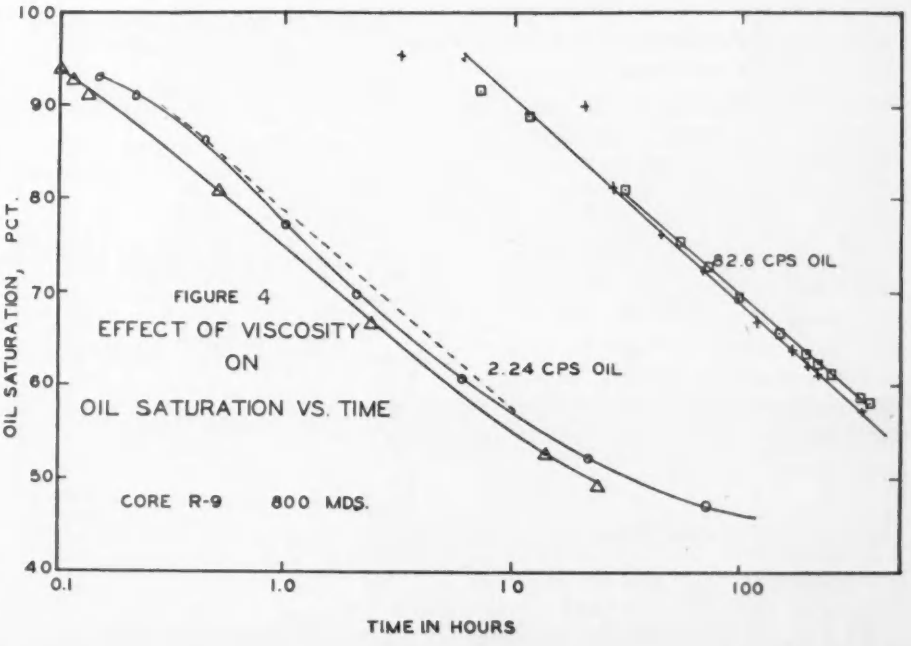
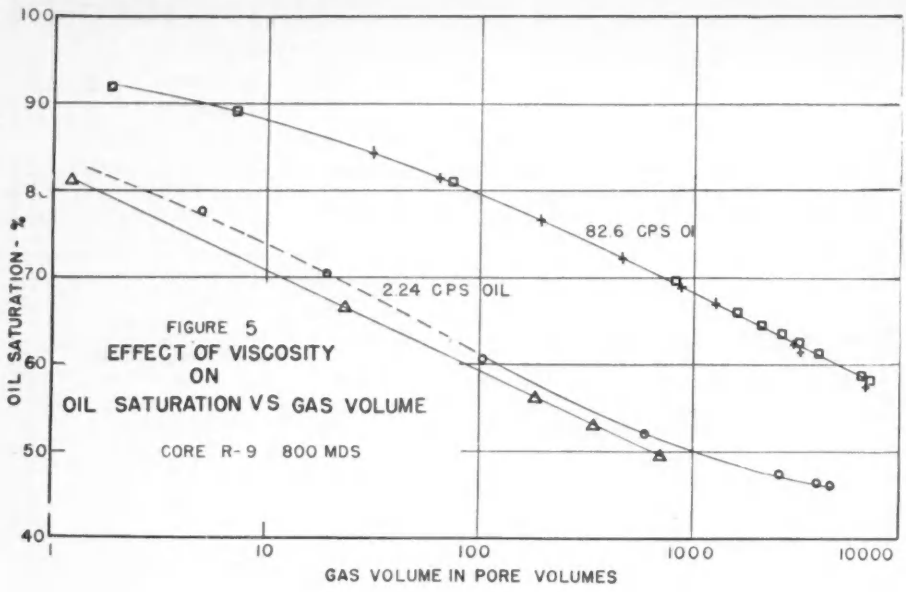


FIGURE 4
EFFECT OF VISCOSITY ON OIL SATURATION VS. TIME



and the experimental points indicated by separate curves. The results show good reproducibility. They are plotted in Figures 4-6 which show saturation versus time, gas volumes, and gas-oil ratios, respectively.

As in experiments with long cores reported on previously,[2] the saturation vs. gas volume curves are linear on semi-log paper over a considerable range. This happens to be related to the fact that the ratio of the relative permeability of the non-wetting phase to that of the wetting phase gives a straight line when plotted against saturation on semi-log paper. In fact Muskat,[3] on the basis of an assumption made earlier,[4] namely that the distance from input to producer may be ignored, derived an equation which gives the above relationship for the gas volume curves. If these simplifying assumptions apply, then below about 80 percent saturation, that is, shortly after the gas phase has broken through at the producing end, the production behavior may be predicted without solving the continuity equation. One may simply assume that the gas-oil ratio (corrected for mean pressure in the core) is given at any time by the relative permeability relations. This is equivalent to saying that the pile-up of oil toward the producing end may be ignored or simply included in the average saturation, or that the production history is the same as if there were a large number of points of injection and production.

Saturation Range

The experiments involving the viscosity of the oil as the dependent variable serve to show how well the simplified theory holds. For convenience, certain pertinent values have been taken from Figures 1-3 and tabulated in Table 1. It will be noted from the table that in the saturation range listed the gas volumes necessary to reduce the saturation from one given value to another, say 75 to 70 percent, are approximately in the ratio of the oil viscosities, which are in the ratio 1 : 2.1 : 3.4; also, the average rate of gas flow over these intervals is independent of the oil used.

Figures 4-6 show the effect of a far greater change in the viscosity of the oil than represented in Figures 1-3. The change represented in Figures 4-6 is about 35 fold. Here the effect of a change in viscosity, calculated on a simple proportionality basis, is indicated by dotted lines, the curves for the low viscosity oil being calculated from those for the high viscosity. Within experimental error, that is, as close as saturations can be measured, the simple proportionality relation holds.

The data of Figures 1-6 may be interpreted to mean that, from the time shortly after the gas breaks through at the producing end, the effect of the oil viscosity on saturation distributions due to material balance considerations is not of sufficient magnitude to prevent predictions based on simple calculations. So far, however, the studies have included only linear systems of relatively short length compared to field dimensions. The question arises as to whether the simplifying assumptions of Muskat may hold reasonably well for field dimensions and flow patterns. Considering the result of the 35-fold change in viscosity one might offhand expect the simple relations to hold for fairly large dimensions when the viscosity change is not too great.

As a start in introducing distance as a variable, some experiments were conducted on sand-packed Lucite tubes of varying lengths. The tubes were 2½ inches in internal diameter and fitted with pressure and conductivity taps, the latter serving for the determination of water saturation. Three tubes have been made up so far, 26, 52 and 106 inches in length. They were filled with acid-washed and fired white sand passing a 115-mesh but not a 150-mesh sieve. They were packed with a 0.2 normal sodium chloride solution in the tubes by running the sand in slowly while the tubes rested on a motor driven shaking table. The permeability was about two darcys.

TABLE 1

Effect of Oil Viscosity on Production From Long Cores

(Numbers 1, 2, and 3 refer to oils 1, 2, and 3 having viscosities of 2.24, 4.77, and 7.55 cp., in ratio 1:2.13:3.38.)

Saturation Range	Time Hrs.			Relative Time		
	1	2	3	1	2	3
75–70	15.6	34.0	60	1.0	2.18	3.84
70–65	26	58.0	100	1.0	2.23	3.84
65–60	49	92.0	190	1.0	1.88	3.88

Saturation Range	Total Gas (Pore Vols.)			Relative Gas Vols.		
	1	2	3	1	2	3
75–70	1.22	2.34	4.3	1.0	1.92	3.53
70–65	3.1	6.2	10.8	1.0	2.0	3.48
65–60	8.7	16	33	1.0	1.84	3.88

Saturation Range	Av. Gas Rate (Pore Vols. per Hr.)		
	1	2	3
75–70	.078	.069	.072
70–65	.119	.107	.108
65–60	.178	.174	.174

Pressure Gradients

A number of air-drive runs have been made with varying pressure gradients, the tubes being initially saturated with 0.2 normal sodium chloride solution. Figure 7 shows liquid saturation vs. air volumes when the pressure drops across the three tubes were 25, 50, and 100 cm. of mercury, respectively. This gives the same average gradient regardless of length. It is seen that again the straight line relationship is obtained on a semi-log plot shortly after air breaks through at the producing end. Within limits of experimental error the points for the three lengths of tube fall on the same straight line. Thus, up to 106 inches from input to producing end, the production history may be calculated by simple relative permeability relations as if there were many points of input and production. That is, the fact that the downstream end must pass more liquid for a given over-all saturation change,

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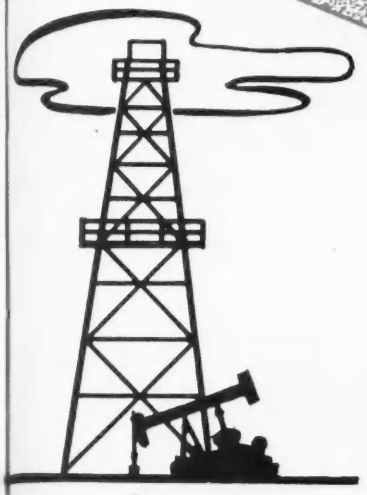

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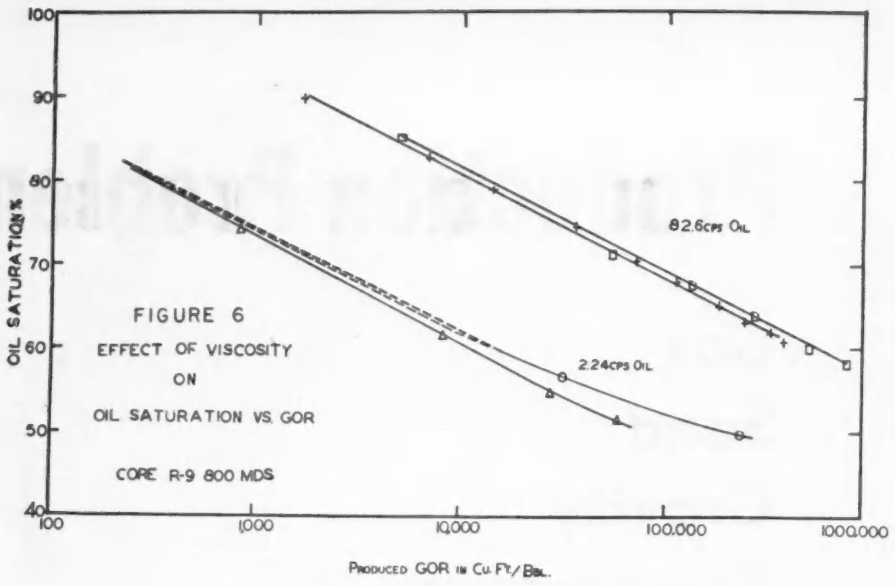

the longer the core, does not affect the saturation gradient enough to show up on the gas volume curves.

To what extent the simplifying assumptions can be made up to field dimensions and radial systems cannot be said as yet. Probably they can be made at somewhat lower liquid saturations than in the case of the laboratory cores. Some evidence for this was found in the analysis of field data by Day and Yuster.[2]

In the experiments on oil-saturated cores the viscosity of only the driven medium was varied. Similar relations between gas-oil ratio and viscosity would obviously apply if a gas of different viscosity were substituted for air. Thus, methane with a viscosity of 0.011 centipoise is less efficient in air-gas drive operations than air with a viscosity of 0.018 centipoise.

Low Viscosity Ratio

It should be pointed out that the relations observed in air-gas drive experiments are due to the low ratio between the viscosities of the driving and the driven media, and the fact that the driving medium is the non-wetting phase. This causes a breakthrough of the driving medium at an early stage. In the case of a water drive, for instance, the oil rate tapers off so fast after breakthrough[5] that it would be difficult to establish any definite relations.

The prediction of saturation at the point of breakthrough of the driving medium has been the subject of some theoretical discussions.[6] Some data on this subject have also been gathered in connection with the above experiments. It is a general rule that the greater the ratio of the viscosity of the driving medium to that of the driven medium the more of the driven medium will be recovered before the driving medium breaks through, provided the wetting relations for the sand are not changed. Where water-saturated cores were oil-driven, for instance, preparatory to some three-phase flow studies, the more viscous the oil the more water was produced before the oil broke through. The relation between the viscosity of the driving medium and the average saturation at breakthrough is of course not a simple one. To obtain the relation would involve simultaneously solving the continuity equation and Darcy's equation employing relative permeabilities. Some attempts at a solution of the problems have been made, but they include some rather questionable transformations involving partial derivatives. The calculations do agree to a certain extent with experimental data, but this may be due to the large part that the relative permeability relations play in the calculations.

Effect on Production

Laboratory studies were presented on the effect of liquid viscosity and of core length on the production history of an air drive. It was found that produced gas-oil ratios were effected on a simple proportionality basis over a 35-fold change in viscosity. It was also found that three sand-packed tubes of 26, 52, and 106 inches in length gave the same curve of liquid saturation versus pore volumes of gas when air driven. The results were interpreted to show the extent to which production behavior might be calculated without the necessity of having to consider saturation gradients. The possibility that such calculations might be reasonably valid for field dimensions and patterns was mentioned.

ACKNOWLEDGMENT

The authors wish to thank S. T. Yuster and other members of the staff of the Division of Petroleum and Natural Gas Engineering for many helpful suggestions, and members of the Pennsylvania Grade Crude Oil Association for their support of this work. They also wish to acknowledge the help of W. O. Crego and C. R. Barr in the performance of some of the experimental work.

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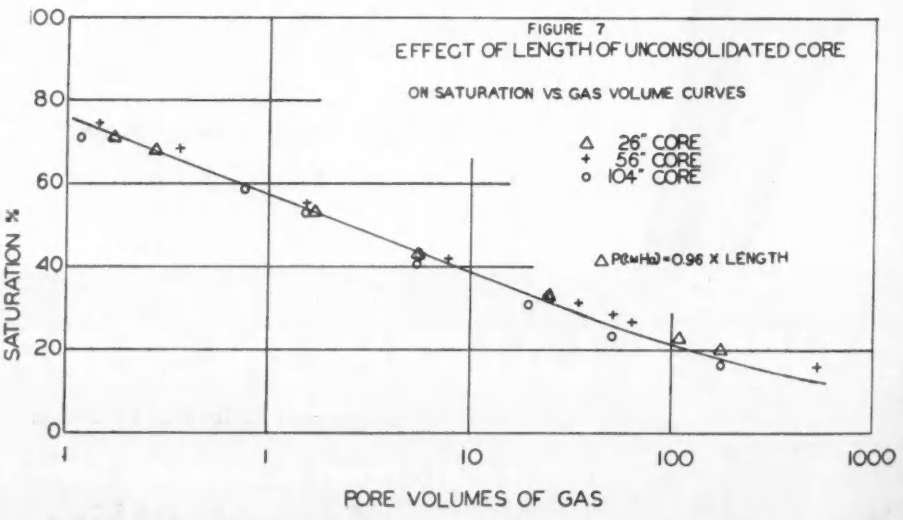

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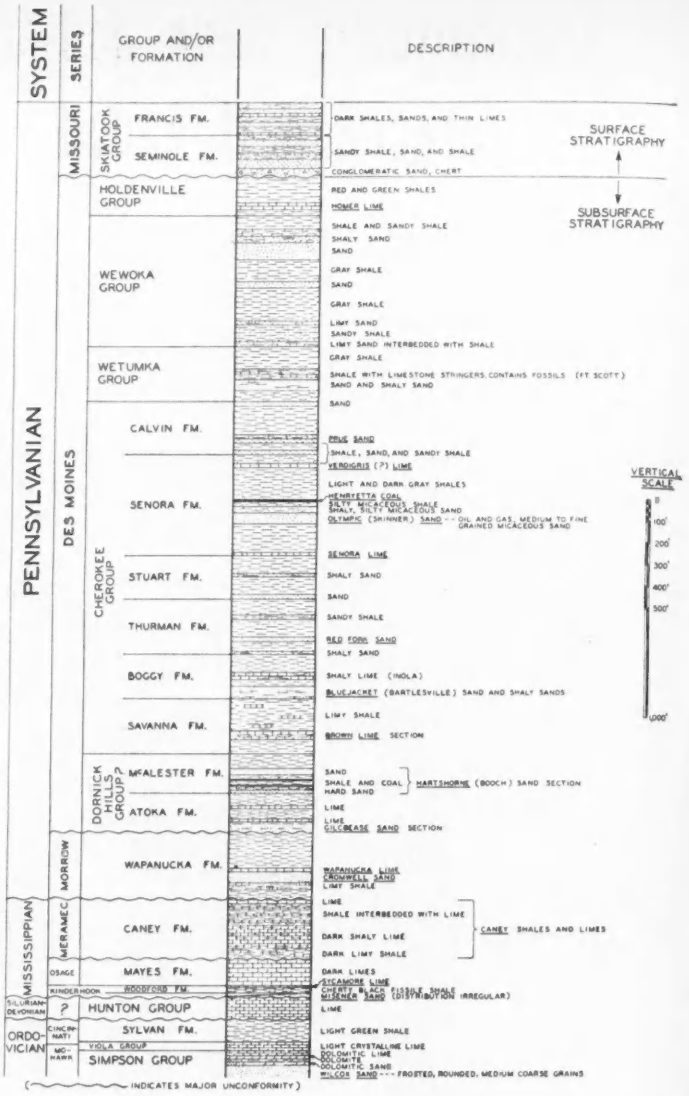
Water-Flood Prospects In Olympic Oil Pool

CRITICALLY EXAMINING the characteristics of a reservoir, the U. S. Geological Survey sets up a pattern for evaluating potential gain in oil in the event that water-flood measures be taken to obtain oil left in the zone after gas-drive energy is spent. The pattern outlined is applicable to similar types of production, regardless of geographical location.

By ANTHONY GIBBON, Staff Writer



Composite stratigraphic section of Olympic field.

A REPORT on secondary recovery possibilities through water-flooding in the Olympic pool of east-central Oklahoma released by the U. S. Geological Survey[1] indicates that more than 13 million barrels of additional oil may be recovered by the application of this technique, and further emphasizes the need for a careful re-check of other depleted oil fields where similar methods may be applied successfully at depths heretofore considered too deep for secondary exploitation. The report should be of interest to producers seeking some technical knowledge of a producing reservoir from which the production has declined through the flush production stage to the stripper phase and still shows possibilities for future development.

The report reviews the early history of the Olympic pool and deals in turn with surface stratigraphy, sub-surface stratigraphy, structure, reservoir performance, characteristics of the Olympic sand body, available resources of secondary-recovery media, and estimates of the volume of oil recoverable by water-flooding methods. The most favorable areas susceptible to the application of water-flooding are cited and the derivation of the recovery factor and its relation to the various classes of productive sand body are discussed in detail.

Survey Report

With the approval of the U. S. Geological Survey, a condensed version of the report is herewith presented.

The Olympic pool is in Hughes and Okfuskee counties between the Canadian River and Wewoka Creek, and about 14 miles due north of Holdenville. It is one of the many prolific oil pools discovered during the development at Seminole.

Embracing 3423 productive acres, the pool was opened July 19, 1934, with the successful completion of the initial well in the Cromwell sand of Pennsylvanian age. However, the chief producing horizon in the field is the Olympic sand, a lenticular sandstone member of the Senora formation (Pennsylvanian) which is about 47 feet thick and is found at depths ranging from 1633 to 1920 feet. The productive area of the field is a narrow belt trending northeastward about 6½ miles and ranging in width from one-half to 1¼ miles. Oil and gas accumulation occurs in a typical offshore bar which by its structure controls distribution of the hydrocarbons.

After production was found in the Olympic sand the field was rapidly defined and development completed by August, 1937, with peak production attaining 11,564 barrels of oil per day, after which a rapid decline in production was registered. The behavior of the

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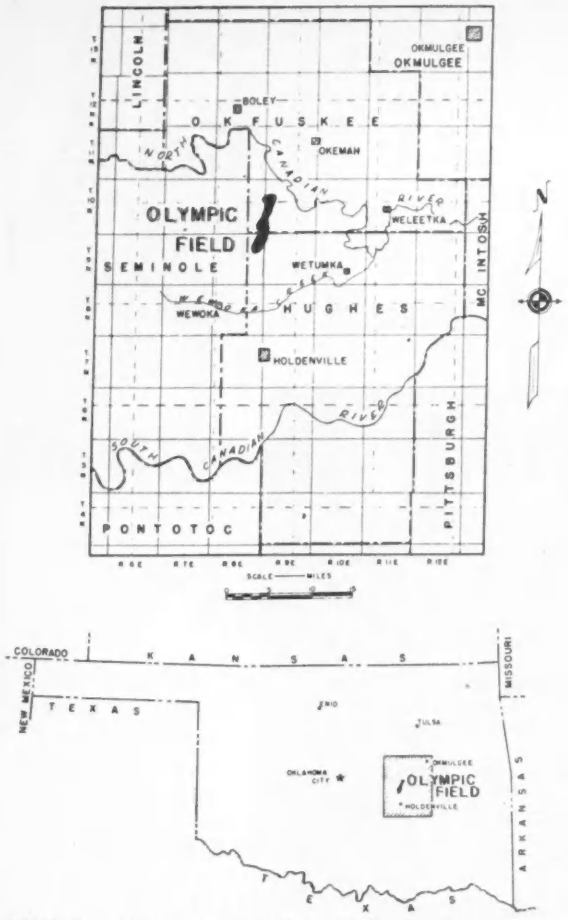
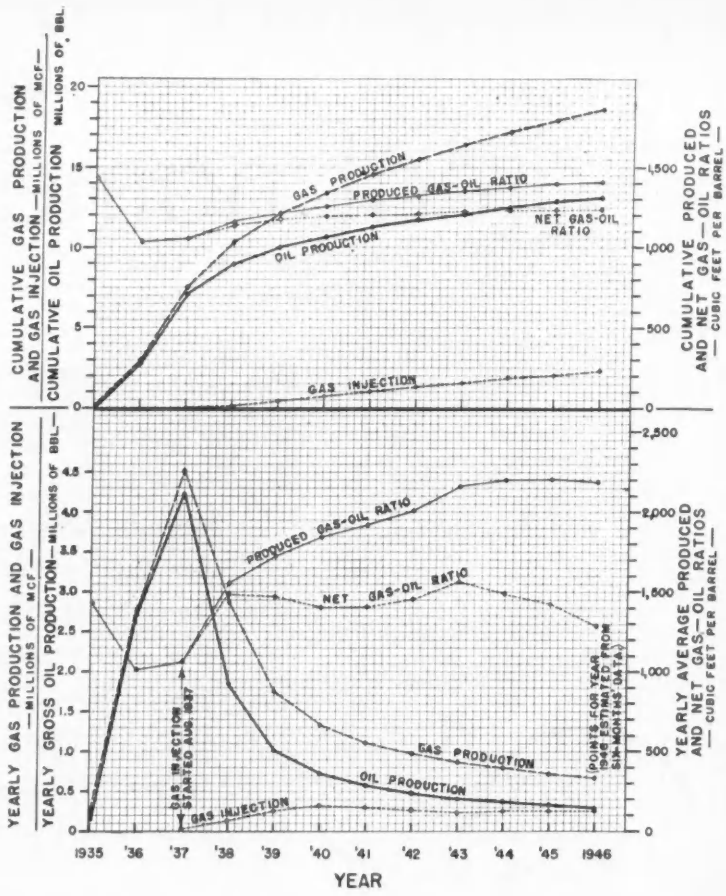


ABOVE: Expanded section of index map showing Olympic field.
BELOW: Index map of Oklahoma showing general location of Olympic field.


CUMULATIVE GAS PRODUCTION AND GAS INJECTION — MILLIONS OF MCF —
CUMULATIVE OIL PRODUCTION — MILLIONS OF BBL.
GAS PRODUCTION
PRODUCED GAS-OIL RATIO
NET GAS-OIL RATIO
OIL PRODUCTION
GAS INJECTION
CUMULATIVE PRODUCED AND NET GAS—OIL RATIOS — CUBIC FEET PER BARREL —
YEARLY GAS PRODUCTION AND GAS INJECTION — MILLIONS OF MCF —
YEARLY GROSS OIL PRODUCTION — MILLIONS OF BBL. —
PRODUCED GAS-OIL RATIO
NET GAS-OIL RATIO
GAS PRODUCTION
OIL PRODUCTION
GAS INJECTION
GAS INJECTION STARTED AUG. 1937
POINTS FOR YEAR 1946 ESTIMATED FROM SIX MONTHS DATA
YEARLY AVERAGE PRODUCED AND NET GAS—OIL RATIOS — CUBIC FEET PER BARREL —
1935 '36 '37 '38 '39 '40 '41 '42 '43 '44 '45 1946
YEAR

Oil and gas production and gas injection history of the Olympic sand, Olympic field.

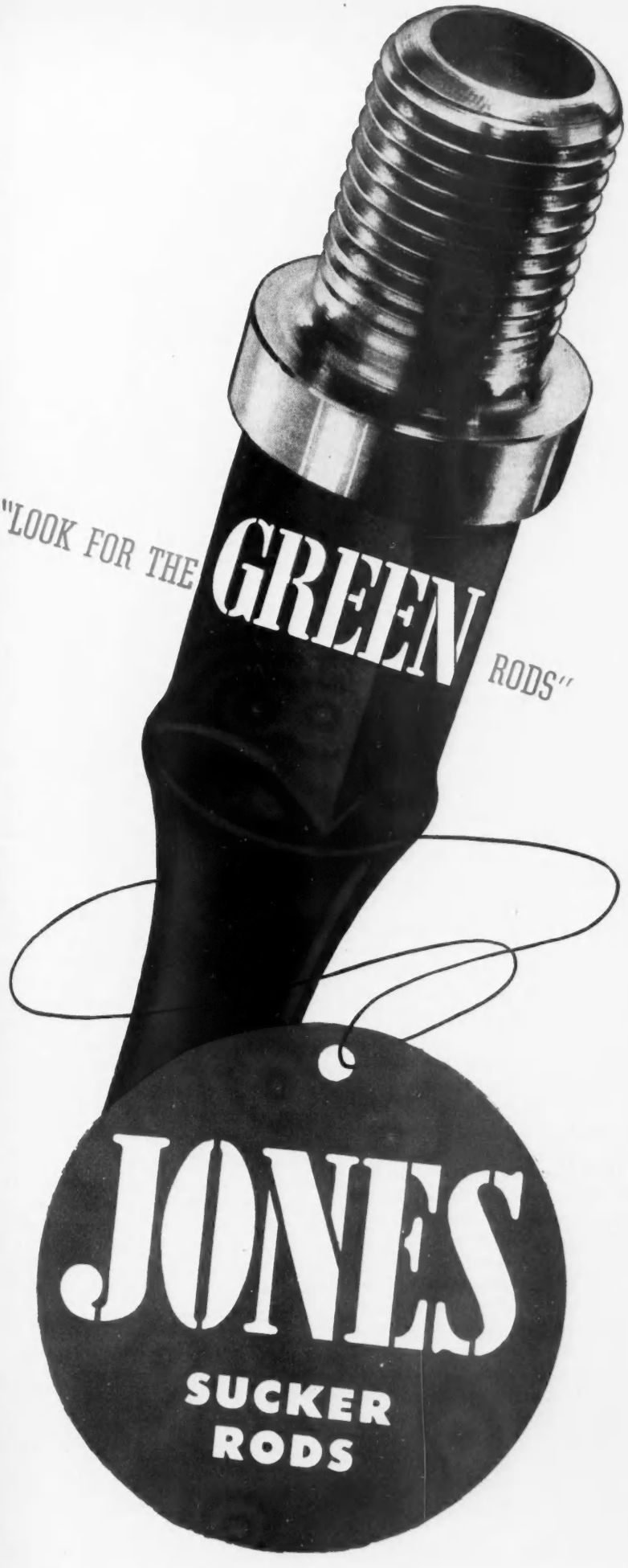
Olympic sand has shown that it is a gas-expansion type reservoir. Many of the wells were completed for an initial production of 300 to 1000 barrels per day and some were reported good for 2000 barrels on initial test. High productivity is indicative of the good producing characteristics of the reservoir such as moderate permeability and general excellent thickness of the producing zone. To July 1, 1946, the report states, the Olympic field had produced 13,202,944 barrels of oil from 347 wells producing from all the productive horizons (Olympic Cromwell, Calvin and Gilcrease sands of Pennsylvanian age, and the Hunton limestone of Silurian-Devonian age), for an average recovery of 3857 barrels of oil per productive acre. Of this volume of oil, 343 wells completed in the Olympic sand produced 12,989,817 barrels, equivalent to a recovery of 3795 barrels of oil per acre. The report indicates from analysis of reservoir performance that the volume of oil produced from the Olympic sand to July 1, 1946, was approximately 15.1 percent of the original 86,215,400 barrels of oil in the reservoir, or its equivalent of 25,187 barrels per acre. Therefore, the oil produced from the Olympic sand is equivalent to the volume of oil occupying eight percent of the pore space in the reservoir.

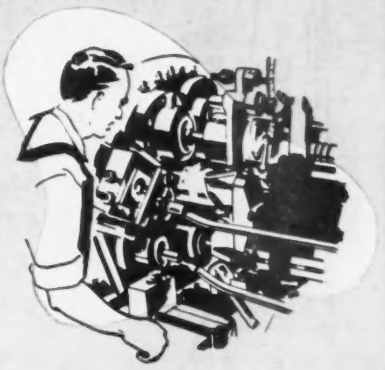
Gas-injection through a system of eight irregularly spaced gas-input wells was initiated in August, 1937, and embraced about 870 acres. It is estimated that this operation has resulted in the recovery of 212,000 barrels. This additional volume of oil averages 244 barrels of oil per pressure-acre as the result of the injection of 2,183,397,000 cubic feet of gas. This is equivalent to 12 per cent of the 18,247,065,000 cubic feet of gas produced from the Olympic sand to July 1, 1946. The gross gas-oil ratio for the Olympic sand amounts to 1405 cubic feet of gas per barrel of oil produced, whereas the net gas-oil ratio is 1237 cubic feet of gas per barrel of produced oil.

The physical conditions of the Olympic sand body are described in the report and the most favorable areas susceptible to the application of water-flooding are cited together with the estimated oil reserves recoverable from these areas. Actual oil reserves and economic oil reserves of the Olympic sand, amounting to 14,623,000 barrels of oil and 13,601,000 barrels of oil, respectively, have been computed volumetrically. Surface and sub-surface water resources adaptable to a successful water-flooding program have been investigated and the report indicates that the future development of the field by water-flooding methods under present economic conditions will embrace about 2775 productive acres which will yield an estimated recovery of 13,601,000 barrels, an average of 4901 barrels per acre.

Lenticular Sand

The history of oil and gas production of the Olympic sand is typical of the performance of a field producing from a lenticular sand by means of gas expansion. Structurally, the Olympic sand is a monocline trending northeast but dipping slightly north of west. General structural features are intercepted by small closed domes and anticlinal noses. For the most part gas, oil, and salt water are segregated gravitationally in the sand. The salt water is downdip on the north, west, and south sides of the sand body and the associated gas is updip in the highest parts of the sand. In





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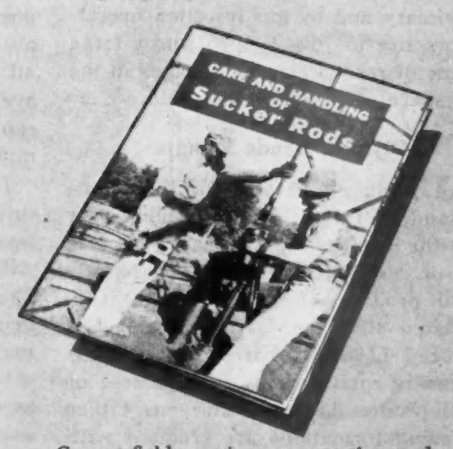

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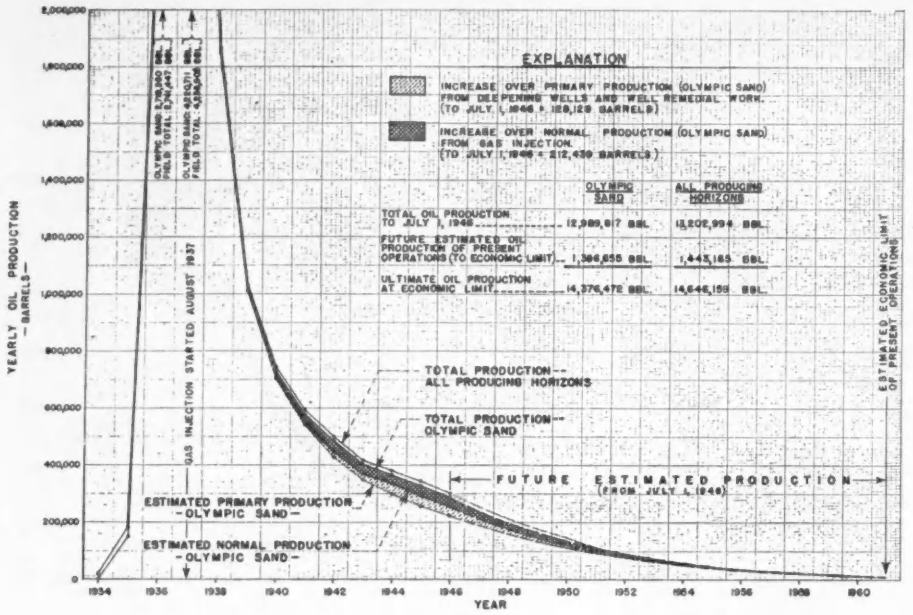

EXPLANATION
INCREASE OVER PRIMARY PRODUCTION (OLYMPIC SAND) FROM DEEPENING WELLS AND WELL REMEDIAL WORK. (TO JULY 1, 1946 = 120,129 BARRELS)
INCREASE OVER NORMAL PRODUCTION (OLYMPIC SAND) FROM GAS INJECTION. (TO JULY 1, 1946 = 212,439 BARRELS)
OLYMPIC SAND
ALL PRODUCING HORIZONS
TOTAL OIL PRODUCTION TO JULY 1, 1946 12,989,817 BBL. 13,202,994 BBL.
FUTURE ESTIMATED OIL PRODUCTION OF PRESENT OPERATIONS (TO ECONOMIC LIMIT) 1,387,655 BBL. 1,443,165 BBL.
ULTIMATE OIL PRODUCTION AT ECONOMIC LIMIT 14,377,472 BBL. 14,646,159 BBL.
YEARLY OIL PRODUCTION - BARRELS -
GAS INJECTION STARTED AUGUST 1937
TOTAL PRODUCTION -- ALL PRODUCING HORIZONS
TOTAL PRODUCTION -- OLYMPIC SAND
FUTURE ESTIMATED PRODUCTION (FROM JULY 1, 1946)
ESTIMATED PRIMARY PRODUCTION - OLYMPIC SAND -
ESTIMATED NORMAL PRODUCTION - OLYMPIC SAND -
ESTIMATED ECONOMIC LIMIT OF PRESENT OPERATIONS
YEAR

Oil production history and future estimated oil production of the Olympic field.

general, the Olympic sand has not been very water productive, and no distinct water-level exists in the sand body.

The rapid decline of the productivity of all oil wells producing from the Olympic sand is an inherent characteristic of the performance of a reservoir in which operations have been unrestricted, with resultant inefficient utilization of available reservoir energy. Accordingly, only a portion of the original volume of oil in the reservoir has been withdrawn by primary and by gas injection operating practice to July 1, 1946, and a large volume of recoverable oil remains in the pore space of the Olympic sand.

Olympic Sands Results

The results of operations in the Olympic sand to July 1, 1946, are consistent with the expected performance of this type of reservoir. Of 13,202,994 barrels of oil produced from this field, it is estimated that the Olympic sand has produced 12,989,817 barrels of oil. This volume is equivalent to 98.4 percent of the oil produced from all horizons. Other producing formations are credited with 213,177 barrels of production, of which the Cromwell sand produced the most oil. The oil produced from the 3423 productive acres of Olympic sand in this field is equivalent to an oil recovery of 3795 barrels of oil per acre.

By primary methods of production, the Olympic sand is estimated to have produced 12,777,000 barrels of oil, or 98.4 percent of the total oil produced from the sand to July 1, 1946. The combination of normal and gas-repressuring methods by July 1, 1946, had reduced the oil saturation of the Olympic sand in this field from the initial volume of oil occupying 53.3 percent of the pore space to a volume of residual oil occupying 45.3 percent of the pore space in the reservoir.

If the field should remain on production by continuation of the operating methods practiced July 1, 1946, it is estimated that future oil production from the Olympic sand by these methods would approximate 1,387,000 barrels of oil. This would result in an ultimate production of about 14,377,000 barrels, or an average recovery of about 4200 barrels of oil per acre. It is estimated that the average oil saturation of the Olympic sand after this withdrawal would not be much less than 45 percent of the voids.

It is expected that a portion of any future oil to be produced by continuation of the current operating practices will be attributed to the injection of gas. Prior to July 1, 1946, this practice had been instrumental in recovering approximately 212,000 barrels of oil from 870 acres comprising the leaseholds, which is equivalent to 244 barrels of oil per acre. The efficiency of this method of operation in terms of volume of oil produced is low, yet gas injection has retarded production-decline, and has extended the productive life of many properties. Of greater significance is that it has demonstrated the fact that much oil remains in the Olympic sand which may be recovered by the application of water-flooding practices.

In estimating the oil reserves of the Olympic sand, the lower limit of residual oil saturation to which the oil content could be reduced efficiently was estimated to be 30 percent of the pore space. The volume of oil recoverable to this terminal oil saturation was estimated to be 14,623,000 barrels from 2775 acres of productive sand apportioned among four classes of sand body. It is equivalent to a recovery of 4200 barrels of oil per acre. Economically, however, a portion of this oil could not be recovered at a crude oil price which averaged $1.60 per barrel for the field on July 1, 1946, including the 35-cent subsidy.

Computing Oil Reserves

Because the operator of a water-flood project expects to make a profit on the investment required, it was considered conservative to compute the oil reserves only from those leaseholds estimated to be capable of producing 2500 barrels of oil per acre by water-flood methods. The present spacing pattern of the field appears to be readily adaptable to the five-spot geometric pattern common to water-flooding development. It is estimated that the actual break-down production of oil could be much less than 2500 barrels per acre—probably in the range of 1100 to 1500 gross barrels of oil per acre. This represents the volume of oil required to amortize the investment in developing the properties and the total cost of operating these properties until the investment is paid out.

So far no appreciable attempt has been made to exploit the Olympic sand in Oklahoma by the application of water-flooding methods of operation. Nevertheless, it is believed that the sand can feasibly be water-flooded, and that a considerable volume of oil can be recovered that might otherwise be lost to the oil industry.

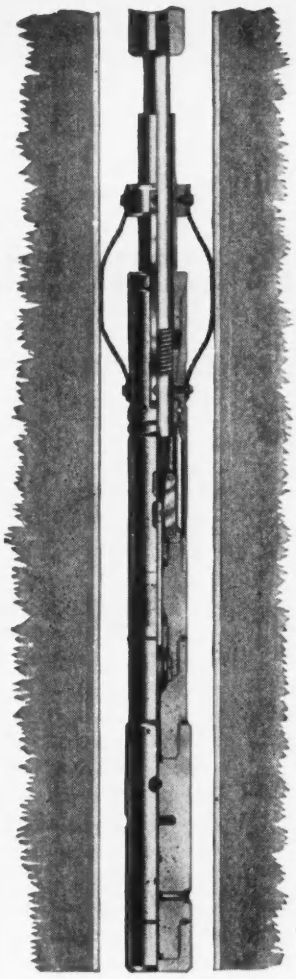
The application of secondary-recovery methods to oil fields producing from formations at depths heretofore usually considered to be below the range of profitable secondary exploitation by the method of water-flooding is being given the utmost consideration by many oil operators in view of the great demand for crude oil and the increasing consumption of petroleum and its products. Not only are these oil reserves of economic importance to the petroleum industry to help meet commitments for crude oil, but the profitable reclamation of such reserves is a conservation measure that will also prolong the productive life of many oil producing properties.

ACKNOWLEDGEMENT

Exhibits through courtesy U. S. Geological Survey.

REFERENCE

[1] "Secondary - Recovery Possibilities of Olympic Field" by I. W. Fox, R. L. Ginter and G. P. Alden (Conservation Branch—Oil & Gas Leasing Division, U. S. Geological Survey). Report consists of 106 pages, 16 tables and 34 plates. It may be obtained by interested operators upon request to the Oil and Gas Supervisor, U. S. Geological Survey, Federal Building, Tulsa, Okla.



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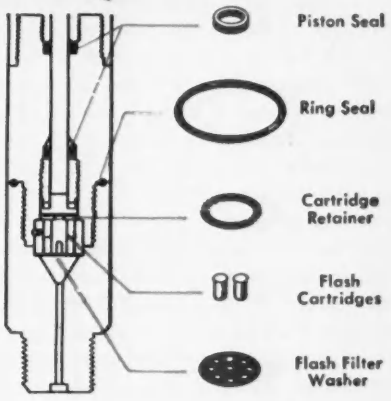

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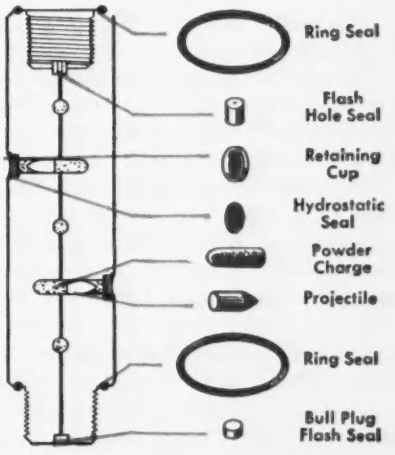

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Acidizing Techniques in Sand Formations

Part 2—CONCLUSION

By EDWARD N. JONES
Petroleum Engineer, Pettus, Texas

TABLE 1 is to show by laboratory tests the actual effect of acids on cements, such as used in the cementing of long strings, squeeze jobs, etc.

The opinion of most oil operators is that acids will destroy the cements in a well. This is only partially true, as can be shown. At one time this was proved to an operator in this manner: Two common cans were used and in each was placed two inches of cement slurry. These were allowed to set for two hours. In one of the cans acid was poured on top of the cement and the other was left undisturbed. The next day each of the two samples was examined and it was found that a very thin white coating was over the cement with acid on it and that the supposed destruction of the cement had not occurred. Ordinary cements, when exposed to a wash acid or a mud acid, react fairly rapidly for a short time only, then the reaction ceases. The phenomenon which occurs is due to the formation of an acid insoluble gel on the surface of the cement which prevents the acid from contacting the undissolved cement. This protects the remainder of the cement unless an acid jet gun or some violent agitation causes the gel to be removed. The amount of cement affected is negligible in a well. The cement which the operators say they have seen removed from a well is generally a contaminated cement. This occurs in a well when there are bad cement jobs caused by channeling, crooked holes, pipe not centered in hole, and many other reasons.

A study of Table 1 will reveal the true characteristics of acids on cements and acids on contaminated cements.

It has been stated that there are two types of acid and that either will have various chemicals mixed with it. These mixtures are for different purposes and accomplish separate chemical reactions beneficial to the sand horizons; therefore, it is desirable to know the type of sand to be acidized, and the sand's predominant characteristics. One sand body may have more lime than bentonite. In this case an operator should use the acid wash and perhaps a small amount of mud acid. Another sand body may have much more bentonite. The operator in this case should use more mud acid with acid wash and use the stage treatment.

A study of Table 2 will reveal the characteristics of sands in the Gulf Coast showing how they vary in their own sand body. The sands differ a great deal in this area as to their depth, characteristics, and behavior, so it would be beneficial to the operator and save money and time to have the sands analyzed at the time of drilling.

The acidizing of cores under pressure was first undertaken, according to the author's belief, in 1946. The apparatus used was built similar to a permeability machine but able to withstand pressures up to 1700 pounds per square inch. The rubber core holder would take a ½-inch square core. The body of the apparatus was built of ½-inch plate steel. The plate steel was cut so that ⅛-inch of steel fitted inside of the metal container holding the rubber core holder. This formed a packoff on top and bottom. Four ¾-inch SAE bolts were used to pull the plates of steel against the outer shell, thereby forming a packoff and causing all of the acids to pass through the core. A ¼-inch outlet was provided on bottom and another on top. Arrangements were made for a gauge as well as lines leading to two containers. One container held acid and the other distilled water (Figure 5). Bypassing the two containers was a line whereby gas could be used to remove all of the fluids from the lines as well as from the core itself. The gas as well as the pressure was supplied by a separator with a reservoir pressure of 1700 pounds.

The procedure of obtaining the results shown in Table 3 was accomplished in the following manner: Cliff Farmer of the Union Producing Company, Beeville, Texas, ran the first analyses of the cores under the column of "Before Acidizing." The cores were then taken to the field and each was placed in the core holder individually. The acids, then distilled water, then gas was alternately forced through the core. On the chart the amount of acid used is under the column "Used in Experiment." The pressures used to force the acids through the core will be found under "Psi Pressure." These cores were removed and the permeability and porosity re-run. The results from this work will be found under column "After Acidizing." The actual results can be observed as well as the trial of using water as an experiment and its effect upon a sand that continued only 5.80 percent bentonite by referring to Core 6.

The acids used were cold, as provision could not be made to heat them. It is well known that acid does more effective work and is greater in its action at a higher temperature. The natural ground temperature of a well will tend to heat the acid, thereby causing a much greater reaction of the acids on the formation.

When the discovery well in the Mack-

About the Author

EDWARD N. JONES began work in the oil fields at 15, and worked as a truck driver, roustabout, pipe line worker, roughneck, tractor driver, pumper, machine shop helper, mechanic and engineer. For 11 years, he was superintendent and engineer for an independent oil company, in charge of the Gulf Coast production, pipe line, transportation, office and machine shop. Jones, who was born at Miles, Texas, attended Texas A. & M. College and the University of Texas. For the past 2½ years, he has practiced consulting engineering.

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hank sand, Wilcox series, located near Pettus, Texas, was drilled, cored, and completed from 7424 feet to 7435 feet, the casing was shot in the sand and the operators completed the well in the usual manner. After completion the well was swabbed dry and would not produce. The tubing was pulled and the well reshot. Again the well was completed with the same results. The tubing was removed again and the sand reshot. Fired into the sand was a total amount of 84 shots consisting of 24-30 caliber and 60-50 caliber bullets. After the third completion the well reacted the same. A 6000-foot string of one-inch was installed in the tubing which was to act as a gas lift. The maximum amount of production from the well was 25 barrels on any one day. This sand was considered as almost non-productive.

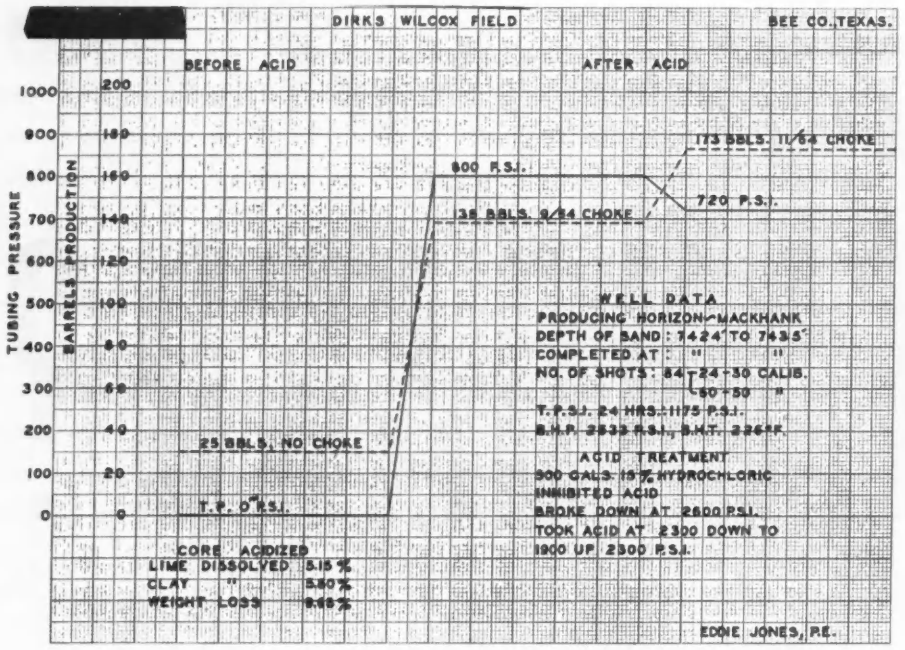

FIGURE 4

A sample of the cored sand was analyzed. The foreign matter in the sand body analyzed as 5.15 percent lime and 5.80 percent bentonite. The weight loss, that is, the portion of the core dissolved, amounted to 9.68 percent. This left the sand approximately 90 percent pure sand by volume. Five hundred gallons of mud acid were recommended. This well had a packer installed on the tubing, shutting off the casing annulus. Acid was pumped into the tubing followed by water. To push the small amount of oil in the tubing back into the sand required 2600 pounds per square inch surface pressure. As acid started back into the sand the formation broke down to 2300 pounds per square inch. After a small amount of acid was forced into the sand the pressure dropped to 1900 pounds per square inch. Near the end of acid injection the pressure increased to 2300 pounds per square inch as the pumps were speeded up.

The one-inch string in the tubing was used to jet the well. After a short time the well was flowing on its own accord through the two-inch tubing with the one-inch still in the well.

The RRC potential test a few days later was 138 barrels of oil, no water, 800 pounds tubing pressure on a 9/64-inch choke. The operators, not satisfied with the quantity of oil, asked for another test, which was as follows: 173 barrels of oil, no water, 720 pounds tubing pressure on a 11/64-inch choke. At a later date the bottom hole pressure was taken. The well had a 24-hour shut-in pressure of 1175 pounds per square inch bottom hole pressure of 2533 pounds per square inch, and a bottom hole temperature of 226° F. (Figure 4).

It would be natural to assume that acids deserve credit for a new discovery as well as a great deal of credit toward increasing recovery from a productive sand that might have been condemned.

The setting of long strings of casing in wells has always been a serious problem to the oil operator. The problem, though it may seem simple, is to have the pipe in the center of the hole and to have a cement slurry fill the annulus between the drilled hole and the outside of the pipe to the desired height in the annulus, thus completely shutting off the

Table 1

Weight of contaminated cement lost with acids.

Sample No.	Mixture	Original Weight	Treated W/Heated 15 Percent Mud Acid	Final Weight	Weight Lost	Percent Loss of Weight
1	*100 Percent Cement 95 Percent Cement	10.92 grams	30 cc	9.98 grams	0.94 grams	8.61
2	† 5 Percent $BaSO_4$ 90 Percent Cement	10.92 grams	30 cc	3.80 grams	87.12 grams	65.20
3	10 Percent $BaSO_4$ 85 Percent Cement	11.00 grams	30 cc	4.80 grams	6.20 grams	56.36
4	15 Percent $BaSO_4$ 80 Percent Cement	11.00 grams	30 cc	5.80 grams	5.20 grams	47.27
5	20 Percent $BaSO_4$ 95 Percent Cement	11.00 grams	30 cc	6.85 grams	4.15 grams	37.72
6	‡ 5 Percent Clay 90 Percent Cement	11.00 grams	30 cc	5.90 grams	5.10 grams	46.36
7	10 Percent Clay 85 Percent Cement	11.00 grams	30 cc	5.55 grams	5.45 grams	49.94
8	15 Percent Clay 80 Percent Cement	11.00 grams	30 cc	4.93 grams	6.07 grams	55.18
9	20 Percent Clay 90 Percent Cement 5 Percent $BaSO_4$	11.00 grams	30 cc	4.37 grams	6.63 grams	60.27
10	5 Percent Clay 80 Percent Cement 10 Percent $BaSO_4$	11.00 grams	30 cc	6.65 grams	4.35 grams	39.54
11	10 Percent Clay	11.00 grams	30 cc	5.90 grams	5.10 grams	46.36
12	100 Percent Clay	11.00 grams	30 cc	3.39 grams	7.61 grams	69.18
13	100 Percent $BaSO_4$	11.00 grams	30 cc	4.50 grams	6.50 grams	59.09
14	Local Sample	11.00 grams	30 cc 15 Percent Wash Acid	6.50 grams	4.50 grams	40.91
15	100 Percent Clay	11.00 grams	30 cc	8.75 grams	2.25 grams	20.46
16	100 Percent $BaSO_4$	11.00 grams	30 cc	9.34 grams	1.66 grams	15.09

NOTE:—*Cement—slow-set. †$BaSO_4$: Barium Sulfate. ‡Clay—High Yield Clay.
Colloidal particles are considered to be 0.000,019,5″ and 0.000,000,393″ in diameter.

Table 2

Acid Soluble Gulf Coast Sands

No. of Samples	Name of Sand	Depth, Feet	Lime, Percent	Bentonite, Percent	Total, Percent
1	Luling	7064–74	0.81	27.19	28.0
2	Luling	7074–84	0.94	30.66	31.50
1	Luling	7050–60	10.15	9.15	19.30
2	Luling	7060–70	3.25	12.85	16.10
1	Luling	7016–26	1.30	12.50	13.80
2	Luling	7026–36	1.60	13.90	15.50
1	Mackhank	7205–15	2.10	10.50	12.60
2	Mackhank	7225–32	7.30	4.30	11.60
1	Slick	6260–?	3.30	15.35	18.65
1	Hockley	3512–28	16.40	37.57	53.97
1	Massive	?	5.15	5.80	9.68
1–6	Slick	?	5.69	15.52	21.21
1	Slick	?	0.57	19.63	20.20

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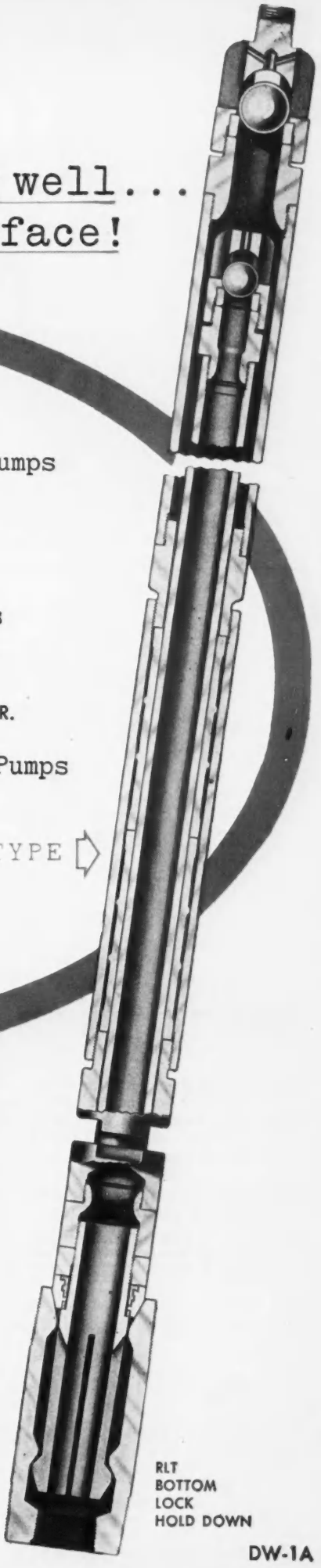

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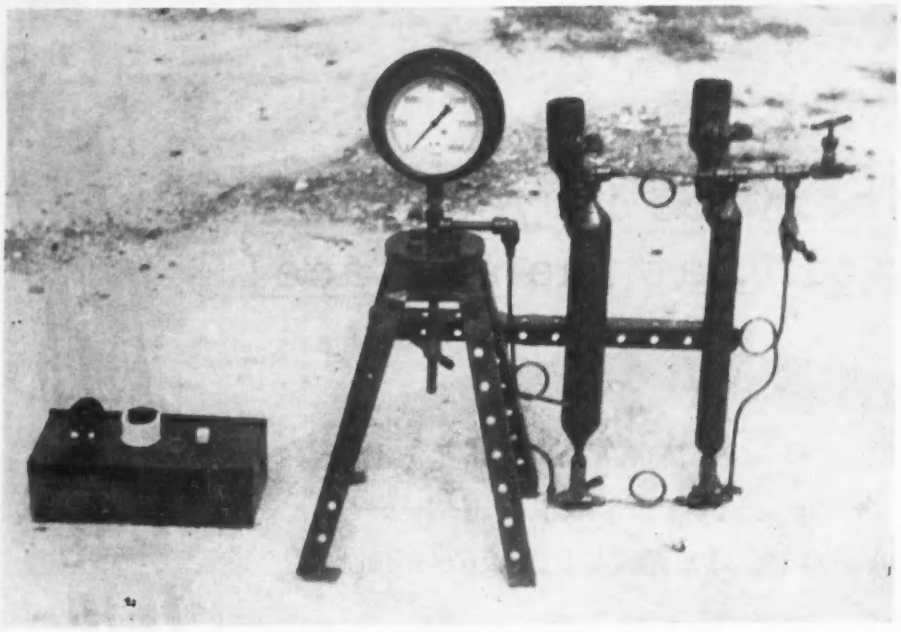

FIGURE 5. Apparatus for acidizing cores under pressure.

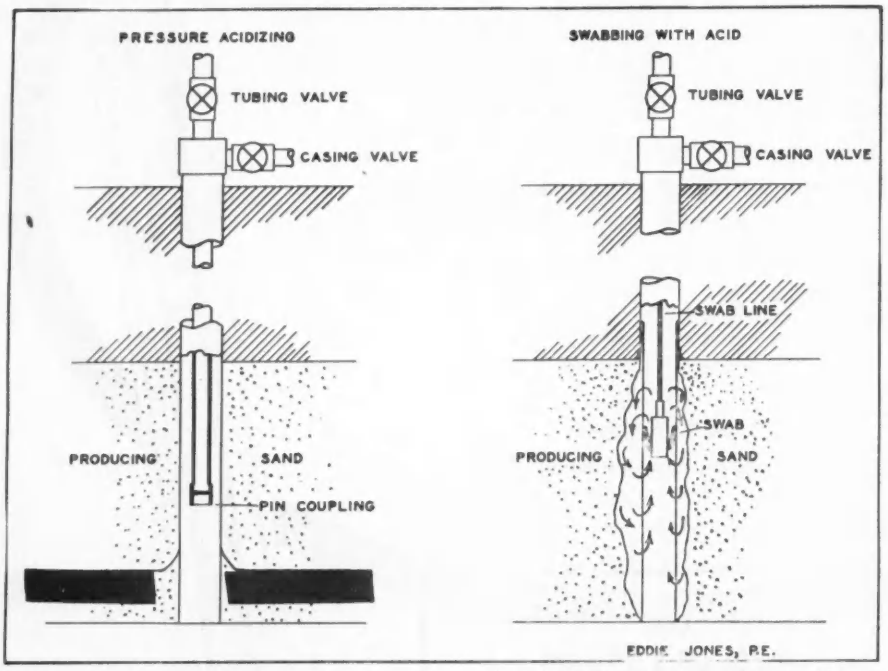

FIGURE 6. Position of the tubing in place in a well (left) illustrates that neither tubing nor surface equipment need be removed in a well that had quit flowing before it was to be acidized.

Table 3
Acidizing cores

Core No.	BEFORE ACIDIZING			AFTER ACIDIZING			Wilcox Sand	Experiment (Used In)	Psi. Pressure
	Perm. Parallel	Perm. Vertical	Percent Porosity	Perm. Parallel	Perm. Vertical	Percent Porosity			
1	125	110	23.2	187	153	30.0	Slick	100 cc Acid 20 cc H_2O Wash	1000
2	173	132	21.9	221	75	31.0	Slick	100 cc Acid 20 cc H_2O Wash	1000
3	71	41	25.0	96	43	30.0	Slick	100 cc Acid 40 cc H_2O Wash	1000
4	59	25	24.0	111	95	32.6	Slick	140 cc Acid 30 cc H_2O Wash	750
5	705	675	27.2	840	735	29.8	Slick	140 cc Acid 100 cc H_2O Wash	750
6	216	42	25.7	221	39	23.4	Slick	See Note No. 1	....
7	40	5	24.5	492	14	31.4	Slick	100 cc Acid 50 cc H_2O Wash	1000
8	435	253	23.6	414	267	23.7	Massive	43 cc Acid could not remove.	100
9	287	228	22.0	461	320	27.2	Luling	100 cc Acid 50 cc H_2O Wash	1200
10	144	118	21.7	275	258	30.6	Luling	140 cc Acid 100 cc H_2O Wash	1000

NOTE No. 1—40 cc tap water, soaked at 700 lbs. Tried acid to 1200 lbs.; did not break down.

various horizons. This is especially important where an operator is trying to shut off water or gas in the same formation from which he desires to produce oil.

Acids have proven that they will destroy muds regardless of whether they are natural or commercial muds. They can be put to advantage in the setting of a long string, although not in every field due to the probability of losing circulation, but in a majority of cases.

The question that would probably be brought up is "will the acid remain after it has been pumped up the annulus and has accomplished its purpose?" Should the acid remain a pure acid this would be a detriment. But it is well known just what quantity of muds one gallon of acid will destroy. The quantity of the mud sheath or the muds in the annulus can be easily calculated. Then the quantity of acids can be calculated whereby the acid will be entirely spent and neutralized by the time the quantity of cement to be used has been pumped to the bottom of the casing.

This idea has not been tried, to the author's knowledge, but it is believed the idea should be tried and tested by a competent authority. The author would like to recommend a procedure which can be tried on wells whereby surface casing is supposed to have cement circulated from top to bottom, the drilled hole to be first calipered and accurate depth measurement taken. The engineer can then calculate the quantity of cement the annulus should hold as well as the amount of muds contained in the annulus. The amount of acid to use can be calculated from these figures. The circulation of the muds and the cements can be observed and timed as to when the acids or neutralized acids reach the surface as compared to the circulating time of the cement. A quantity of the acid can be bottled and tested to see if the acid is strong enough to harm the casing. Acids have an inhibitor mixed in the chemicals to protect the steel pipe. In making this experiment a water spacer should be run before and after the acids used.

This idea, if worked on, can be very beneficial to the operator as the cost of the acids will in all probability never exceed $200 which, if helpful, will certainly save considerable time, expense and uncertainty on cementing jobs.

The use of acids ahead of squeeze jobs is not widespread at present, but when the method is understood and its value realized this specialized procedure should become more popular.

The use of acids before squeeze jobs was first tried by the author in the Pettus area during the latter part of 1943 on a well that had been squeezed eight times by the now standard method

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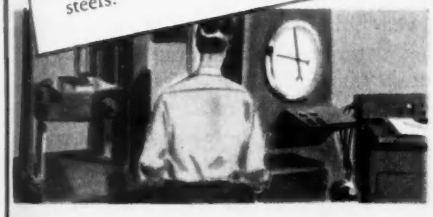

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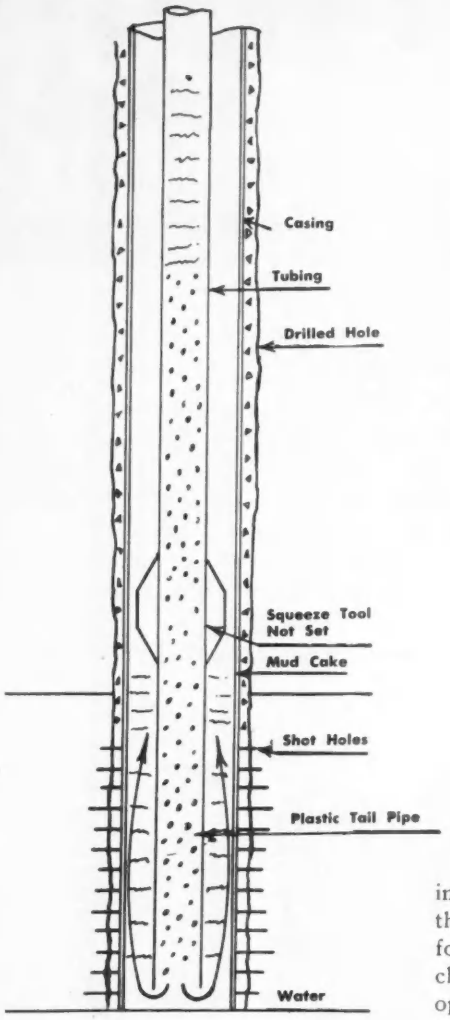
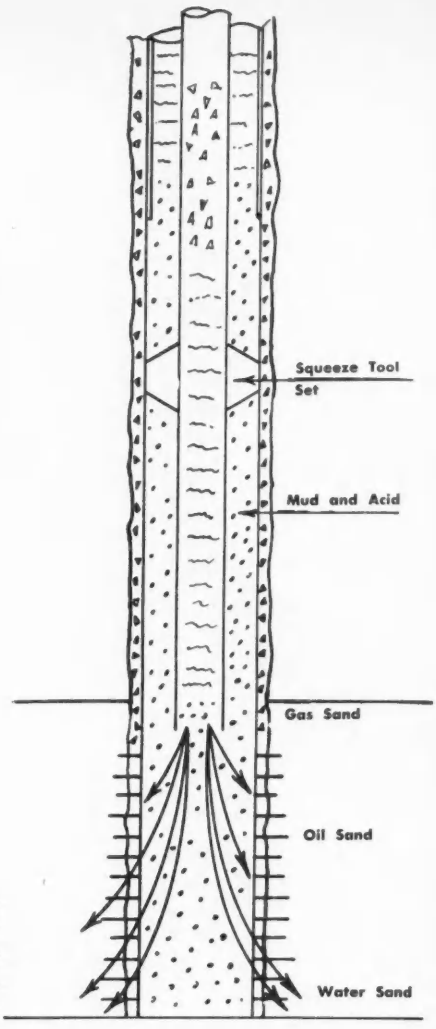
FIGURE 7



PERTINENT STEPS

1. Squeeze tool required that can be circulated through whether set or unset.
2. Plastic tail pipe of sufficient length to go below perforations and keep rubber on squeeze tool above shot holes.
3. With tail pipe on bottom, run in 10 barrels of water and 500 gallons of acid.
4. Displace acid in tubing with water until acid on bottom. Acid opposite formation, soak, squeeze and release pressure until most of acid used up.
5. Raise squeeze tool until bottom of tail pipe above perforations then set squeeze tool and break down. Start cement and squeeze as any regular squeeze job.



of squeezing. The first application was successful and was given credit for completely shutting off water the well was producing.

Statistics of acidizing before cementing on squeeze jobs are not available, but from data of 78 case histories on hand the average of the successful jobs would approximate 92 percent. These jobs have included squeezing off water as well as reducing gas-oil ratios of wells.

The muds in a well are a necessity to the drilling of a well or the control of a well, but these same muds can become a hazard and a real detriment in obtaining a shutoff of water or gas in a well.

The question will probably be asked, "Why do muds hinder a squeeze cementing job?" The answer is theoretical as one has to assume so many various factors.

Theoretically, a well that is producing water is producing the water from the most permeable spot of the sand horizon in which the well is completed. This would hold true in sand bodies that contain a high percentage of bentonites. In many instances a well has been producing oil for several years without producing any water. Suddenly it starts to produce water and the water percentage increases rapidly. One would assume that this is water from the producing formation and that it is not caused by channeling around the pipe. The average opinion is that the water table is rising in the formation rather rapidly or that a coning effect is being maintained at the producing area. The coning effect is more likely and the increase of water can be explained in this manner. The water table has risen to a point within the peripheral pressure zone. This zone may extend some distance back into the sand body, which may be very erratic in its contours. Regardless of the pressure zone the well is making water to such an extent as to cause it to quit flowing, trapping unproduced oil.

The water level, commonly called the water table, reaches the lower pressured zone and tends to come into the formation then into the well. The water, in traveling through the formation, removes the bentonites contained in the sands, thereby removing this obstruction and increasing the permeability in the void spaces, thus allowing the water to move through the formation at a more rapid rate. Water, having 2½ times the surface tension of oil, causes the water to be produced at a much more rapid rate. One would then assume, with this explanation, that the most permeable spot would be the portion of the sand body producing the water.

The operator in killing a well does so by using muds which are pumped to the bottom and circulated. The mud, having a higher hydrostatic pressure than the formation pressure, controls the well. Often little or no attention is given to water loss of the mud, which is a very important factor. Even though the water loss is low some water will enter the formation. This water will naturally go to the most permeable spot, thereby causing the sands to filter out the muds and the muds to form a heavy, durable mud sheath over this area which will not break down unless the mud cake is removed. The acids will remove the mud cake and will play one of the most important parts of a squeeze job. The mud cake removed and the most permeable portion of the sand exposed will allow the formation to be broken down at this point, thereby allowing this area to receive the cement and to be plugged off.

The selection of the squeeze tool and the manipulation of the tool is a very important factor. The squeeze tool must be of a type whereby all fluids circulated will go through the tool and out at the bottom of the plastic tail pipe whether closed or not. The plastic tail pipe will have to be long enough to extend below the perforations and the packer rubber will not be forced to go

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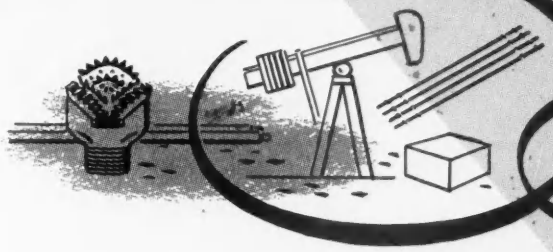

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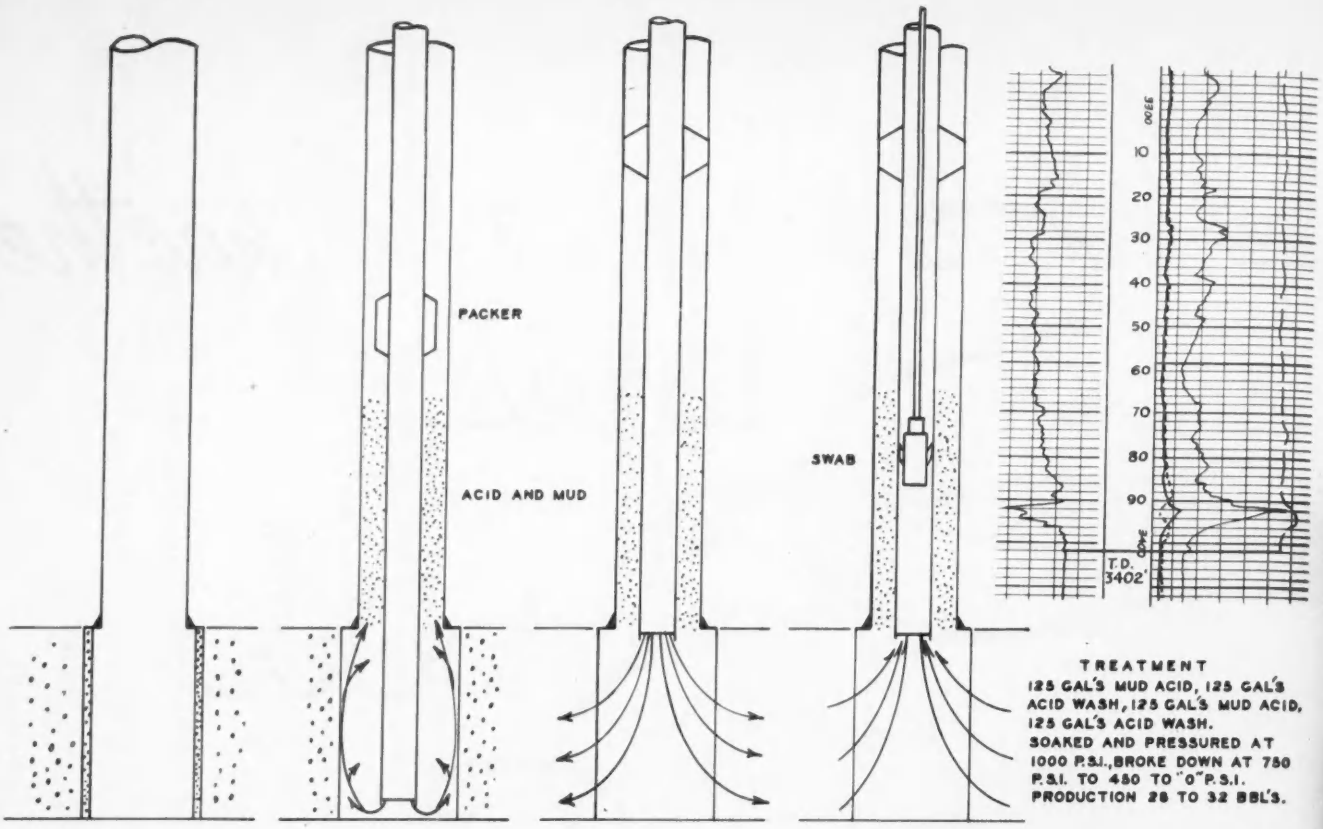

CORE ANALYSIS						ANALYSIS OF DISSOLVABLE MATERIAL			
	Permeability		Percent	Per. Pore Space			Percent	Bentionite	
DEPTH	Par.	Vert.	Porosity	Oil	Water	DEPTH	Lime	Percent	Total
3382-84	37	31	39.0	12.8	65.6	3382-86	0.04	27.75	27.79
3384-86	11	5	38.4	14.1	65.4	3386-89	0.04	29.17	29.21
3386-89	450	312	36.5	22.5	51.8	3389-94	0.04	29.92	29.96
3389-94	581	278	37.5	32.0	35.2	Natural Mud	11.67	49.50	61.17
						No record of water lost in formation.			

FIGURE 8. Method used in acidizing a well in the Hockley Sand, Holzmark area. Electric log shows type of sand and sand thickness. Core analysis indicates dissolvable material in the formation averaged 29 percent upon which acid could be effectively used.

below the perforations in the casing.

The squeeze tool, with the plastic tail pipe, having been run in the hole and stopped at a point below the perforations or at the bottom of the hole, the operator is ready to start squeeze operations. The steps are listed in the following order:

1. Squeeze tool is not to be set as circulation must be maintained through tail pipe.

The circulation point of the tool, whether through the tail pipe or in the packer body, should be below the perforations that the operator desires to squeeze. The effect of removing the muds will not be effective if this is not done.

2. A quantity of clear water is put into tubing to be used as a spacer between mud and acid. Acid coming in contact with the muds will destroy them.

3. The quantity of acid necessary is then pumped into the tubing. The quantity is determined by several set rules, but in general one would use 500 gallons as this is the least amount an acid company will deliver.

4. Following the acid another quantity of clear water is pumped into the tubing. This is used as a spacer as well as a neutralizer between the acids and the unset cement. This amount varies according to opinions. At least 20 barrels should be used so the acids will become completely neutralized. On most squeeze jobs where acid is used the quantity of cement used is a great deal less than on the other type of jobs. The cements seem to set quicker and harder. The reason for this has not been definitely determined but it is assumed that when the raw cements come in contact with the calcium chloride this causes the cement to flash set. The hard setting of the cement could also be caused by the surfaces being cleaned of all muds, therefore, the cements not contaminated set up harder and have a tighter bond with the surfaces. The contact of the cement with calcium chloride could cause a flash set by the cements entering the salt water horizon, or the effect of the acids on the lime in the formation or in the mud.

5. The quantity of cement desired is then pumped into the tubing.

6. Mud is then pumped into the tubing as on any other type of squeeze job.

The steps having been listed, the procedure is easily explained. Carefully calculating the amount of fluid the tubing will hold, one uses this as a measuring stick. When the acid reaches bottom the pumps are slowed down to where only small amounts of fluid are being moved. This allows the acids to work on the mud cake and remove this cake from the well bore. Stopping at short intervals will be more beneficial. After approximately one-half of the acids has been pumped past the formation, the balance remaining in the tubing, the squeeze tool is raised to the desired height for working room and is closed. The formation is broken down with acid and the balance of the acid in the tubing is pumped back into the sand ahead of the water spacer and the cement. The balance of the procedure is the same as on any squeeze job.

Clear water has been tried with the same assumptions of cleaning away the mud cake, but all the clear water accomplished was the removal of the circulating muds and not the mud cake.

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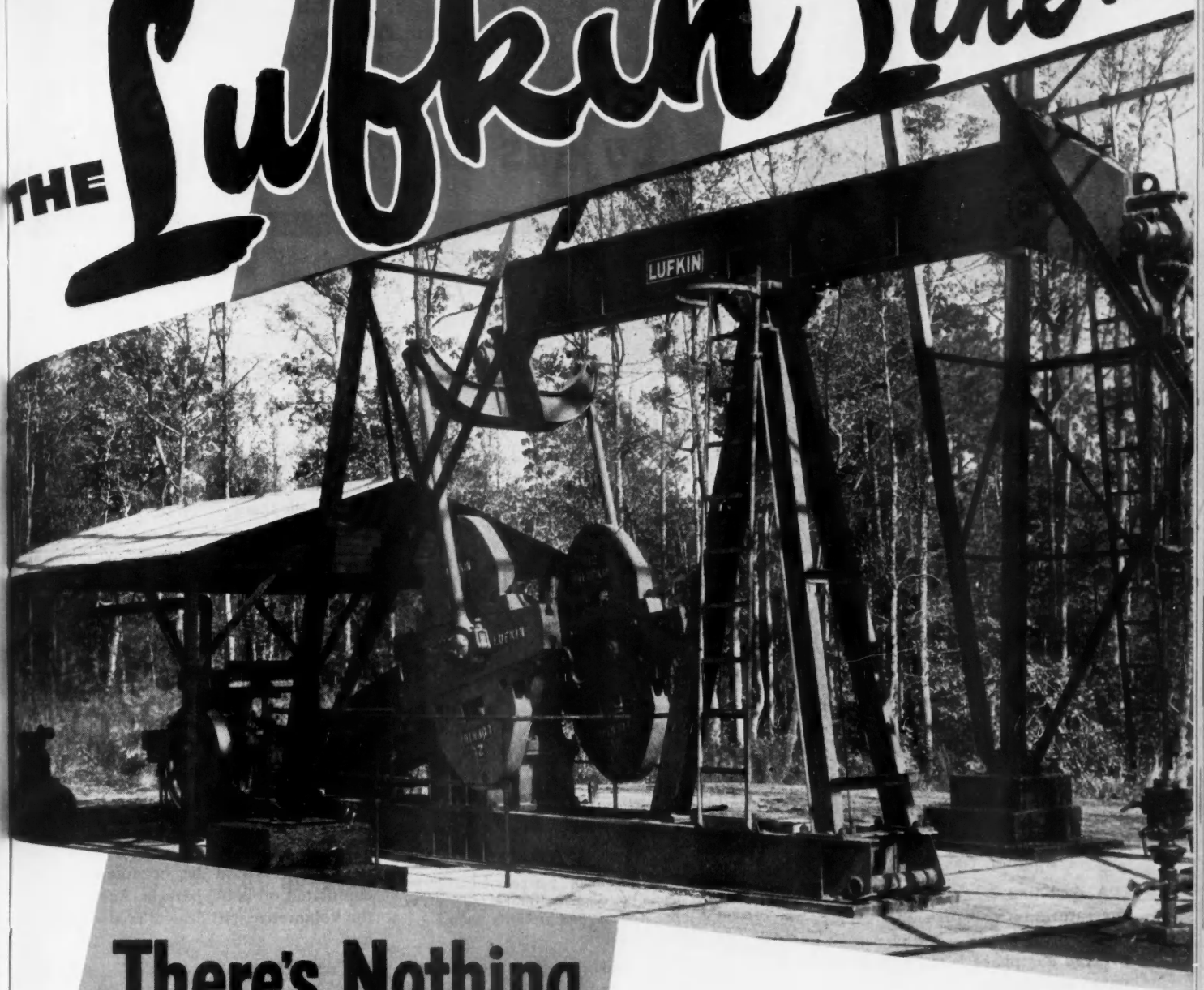

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Oil Production by Gas and Flooding

Part 7

DECLINING RESERVOIR PRESSURE

THE probable ultimate oil recovery by solution gas is 23 percent plus or minus 7 percent. The lower or 16 percent limit is for a high degree of oil and gas migration from less to more permeable beds as in some limestone reservoirs. The upper or 30 percent limit is for approximately uniform but very high per-bed permeability in which help from gravity is significant. Injection of solution gas is accompanied by declining reservoir pressure. Because of shrinkage, oil recovery by injection of solution gas is much less than that by pressure maintenance. Hence, oil production by solution gas and by the injection of solution gas should be avoided where possible.

Solution Gas-Oil Ratios

A declining reservoir pressure below the saturation pressure for an oil is accompanied by vaporization. The initially evolved gas phase is predominantly propane and lighter containing some butanes plus. But at very low reservoir pressures, the gas remaining in a reservoir may be predominantly butanes plus. Therefore, the gas-liquid ratio for oil production by evolved gas increases to a maximum and then declines and tends to approach zero.

Gas-Oil Ratio Basis

Let the initial pressure equal the saturation pressure for the oil. Let the reservoir contain S barrels of space occupied by a reservoir liquid for which the initial volume factor is b_o. Accordingly, the in place oil is S/b_o barrels. Denote the gas in solution at the initial pressure by g_o and at a declined pressure, by g cubic feet per barrel of oil.

At any reservoir pressure P less than P_o the saturation pressure, there would be Sg/b_o cubic feet of gas in solution and $S(g_o - g)/b_o$ cubic feet of free gas provided expansion could take place without producing any oil and gas. The space occupied by the free gas would be

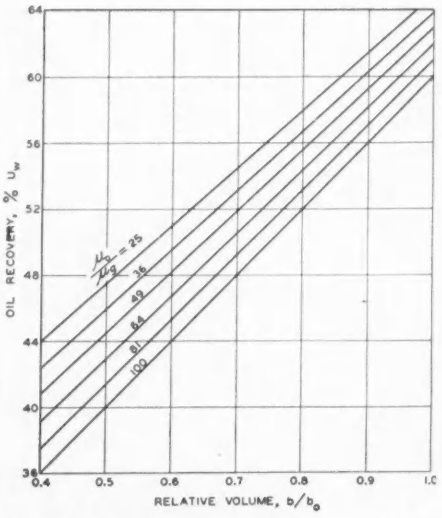

FIGURE 7-1. Maximum per-bed oil recovery from the pay in the vicinity of producing wells vs. relative volume and viscosity ratio.

$BS(g_o - g)/b_o$ where B is the volume factor for gas in barrels per cubic foot.

On the other hand, the space occupied by the reservoir liquid for no production of oil would decrease from S to Sb/b_o barrels where b is the volume factor for oil at a declined pressure. Aside from production and no change in reservoir space we would have $BS(g_o - g)/b_o$ barrels of reservoir gas and Sb/b_o barrels of reservoir liquid. But the volume of gas and liquid must be contained in S barrels of space. Therefore the sum of the respective fluid volumes less reservoir space is the volumetric withdrawal A in barrels. Thus

$$A = \frac{S}{b_o}[B(g_o - g) + b - b_o] \qquad (1)$$

The volumetric withdrawal A represents a cumulative oil recovery of C barrels. Let R be the average gas-oil ratio for the C barrels of oil. At the pressure P there are g cubic feet of gas in solution. Consequently, the production of free gas is $C(R - g)$ cubic feet. The space that would be occupied by produced free gas is $BC(R - g)$ barrels. The space that would be occupied by accumulated oil is bC barrels. Accordingly, the volumetric withdrawal is also defined by

$$A = C[B(R - g) + b] \qquad (2)$$

Hence, oil recovery U expressed as a fraction of in place oil equals Cb_o/S and is defined by

$$U = \frac{B(g_o - g) + b - b_o}{B(R - g) + b} \qquad (3)$$

The Unit Gas-Oil Ratio

Let r equal the average produced

TABLE 7-1

Oil Recovery for Unit Gas-Oil Ratio
Reservoir Temperature = 211° F.

Psia.	g	(1002-g)	Z	1000B	B(1002-g)	b	N[a]	Percent U_w[b]
5000	1002	....	1.00	0.6764	.....	1.473	.....	....
4750	938	64	0.99	0.7048	.....	1.448	.....	....
4500	873	129	0.98	0.7365	0.0950	1.423	0.0450	2.96
4250	810	192	0.97	0.7718	0.1482	1.399	0.0742	4.80
4000	749	253	0.95	0.8032	0.2032	1.375	0.1052	6.67
3750	690	312	0.94	0.8477	0.2645	1.352	0.1435	8.88
3500	633	369	0.93	0.8986	0.3316	1.330	0.1886	11.35
3250	579	423	0.92	0.9573	0.4049	1.308	0.2399	14.01
3000	527	475	0.91	1.0258	0.4873	1.287	0.3013	16.98
2750	476	526	0.905	1.1129	0.5854	1.265	0.3774	20.42
2500	428	574	0.90	1.2174	0.6988	1.246	0.4718	24.26

a. $N = B(1002 - g) + b - 1.473$.
b. Oil recovery for produced gas-oil ratio = 1002 cu. ft./bbl.; $R/g_o = 1 = r$.

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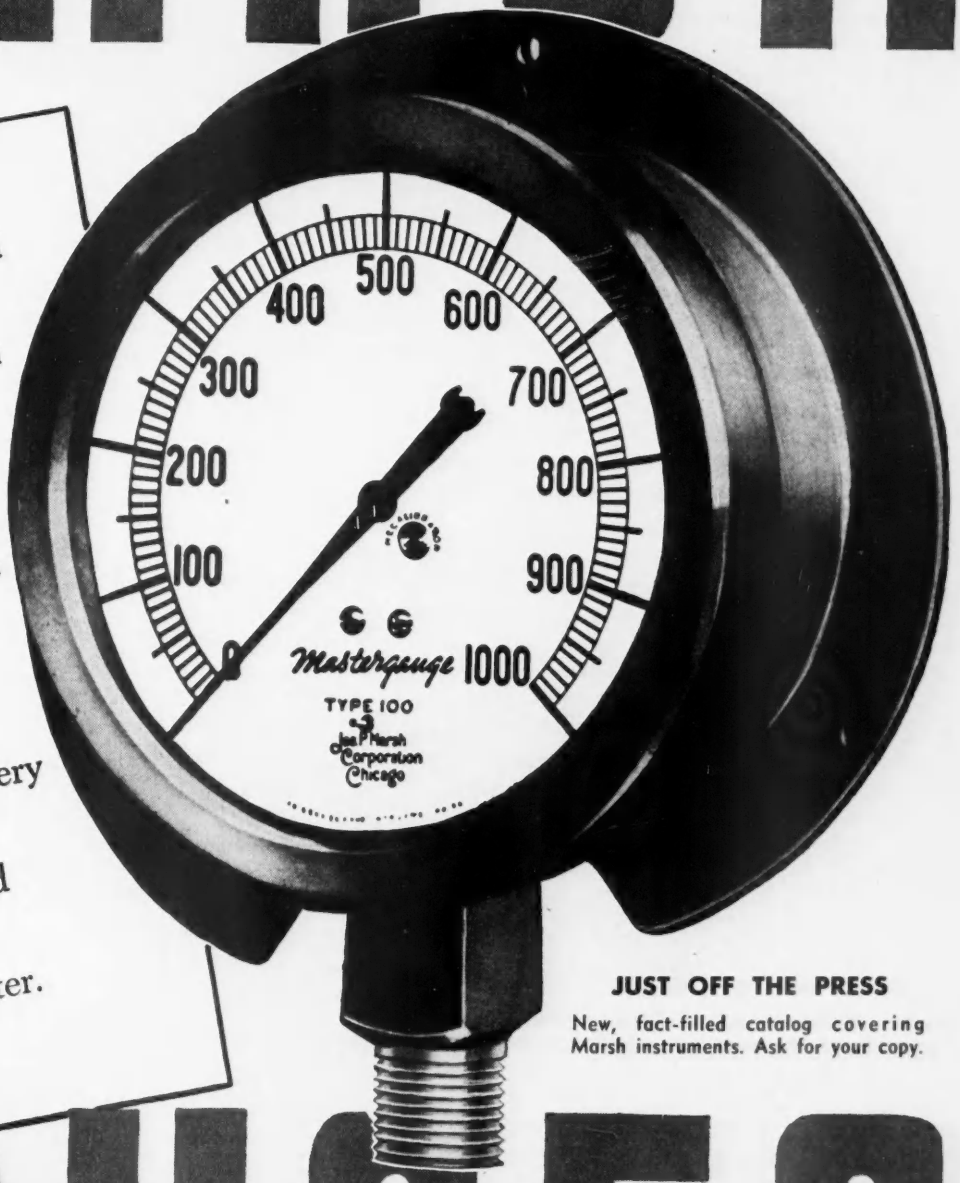

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gas-oil ratio divided by the gas-oil ratio at saturation pressure, that is,

$$r = R/g_o \qquad (4)$$

Equation (3) may now be written as follows:

$$U_r = N/D_r \qquad (5)$$

where U_r is the oil recovery corresponding to a produced gas-oil ratio which averages r times the gas in solution at saturation pressure. The numerator N of equation (3) does not vary with the produced gas-oil ratio for a given reservoir.

Table 7-1 shows the oil recovery for a unit gas-oil ratio. The saturation pressure is 5000 psia at 211° F. There are 1002 cubic feet of gas in solution at the saturation pressure. If oil could be produced with a unit gas-oil ratio for a pressure decline to 2500 psia, oil recovery would be 24.26 percent of in place oil.

Higher Gas-Oil Ratios

Table 7-2 shows solutions of equation (5) for gas-oil ratios ranging from unity to 3.0. For a gas-oil ratio of 3.0 oil recovery at 2500 psia would be 10.73 percent of in place oil.

Table 7-3 shows oil recovery for a reservoir in which the saturation pressure was 2500 pounds per square inch absolute at 160° F. The gas in solution at saturation pressure was 567 cubic feet per barrel. The volume factor at 2500 psia was 1.333 barrels per barrel of oil. At 200 psia, there were 161 cubic feet in solution. For a 4.0 gas-oil ratio, oil recovery is 18.12 percent of in place oil. The other U_r values show what the cumulative recovery would have been if it were possible to produce oil with gas-oil ratios less than 4.0.

TABLE 7-2
Oil Recovery at 2500 Psia vs. Gas-Oil Ratio

r	1.0	1.5	2.0	2.5	3.0
R	1002	1503	2004	2505	3006
(R-g)	574	1075	1576	2077	2578
B(R-g)	0.6988	1.3087	1.9186	2.5285	3.1494
D_r	1.9448	2.5547	3.1646	3.7745	4.3954
% U_r	24.26	18.47	14.91	12.50	10.73

Basis: N=0.4718; g_o=1002; 1000B=1.2174; g=428; b=1.246.

Produced Gas Basis

Suppose oil is produced by evolved solution gas only. Aside from loss of oil to gas at gas-oil ratios R greater than g_o, the in place gas is Sg_o/b_o cubic feet. Let V equal the produced gas expressed as a fraction of in place gas. Then the cumulative oil recovery at any time is defined by

$$U = \Sigma\Delta U = \Sigma\left(\frac{\Delta V}{r}\right) \qquad (6)$$

As an example, suppose the relative gas-oil ratio r were 1, 3, 5 and 7 respectively for the first, second, third and fourth 10 percent increase in cumulative gas production. Then

$$U = \left[\frac{10}{1} + \frac{10}{3} + \frac{10}{5} + \frac{10}{7}\right] = 0.1676$$

The oil recovery is 16.76 percent. The relative gas-oil ratio averaged 40/16.76 or 2.39. As 60 percent of in place gas still remains in a reservoir, the peak gas-oil ratio was not reached in this example.

Oil Recovery from Sections

Produced gas-oil ratios for declining reservoir pressures vary with the properties of in place reservoir liquid, per-bed permeability ratios and location of wells. First consider one bed for which the location of wells is regular, staggered or random. The source of the initial production is in the immediate vicinity of individual wells. But as reservoir pressure declines, the source of production recedes and ultimately reaches a most distant section. Other things equal, a most distant section is located about midway between a well and its offsetting wells.

Oil recovery from a most distant section is by evolution of in place gas only. Therefore oil recovery from a section of negligible extraneous gas cannot exceed the breakthrough recovery U_b defined by

$$U_b = 20 - (\mu_o/\mu_g)^{1/2} \qquad (7)$$

where U_b is aside from gravitational migration and vaporization of oil at very low pressures. As the ratio of reservoir liquid viscosity to that of gas increases and the volume factor for the remaining oil decreases with pressure decline, oil

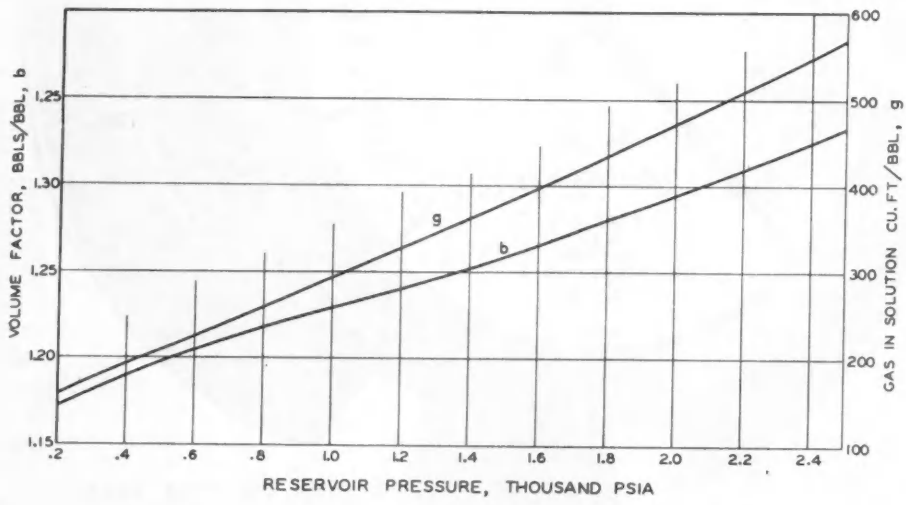


FIGURE 7-2. Volume factor b and gas in solution g vs. reservoir pressure at 160° F. for a 26.7-degree oil with 567 cubic feet per barrel in solution at 2500 pounds per square inch absolute.

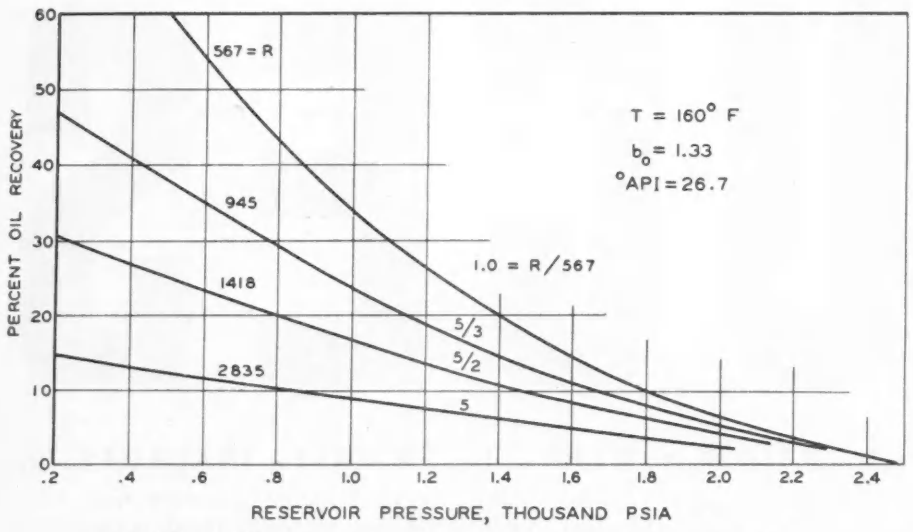


FIGURE 7-3. Oil recovery vs. reservoir pressure and produced gas-oil ratio.

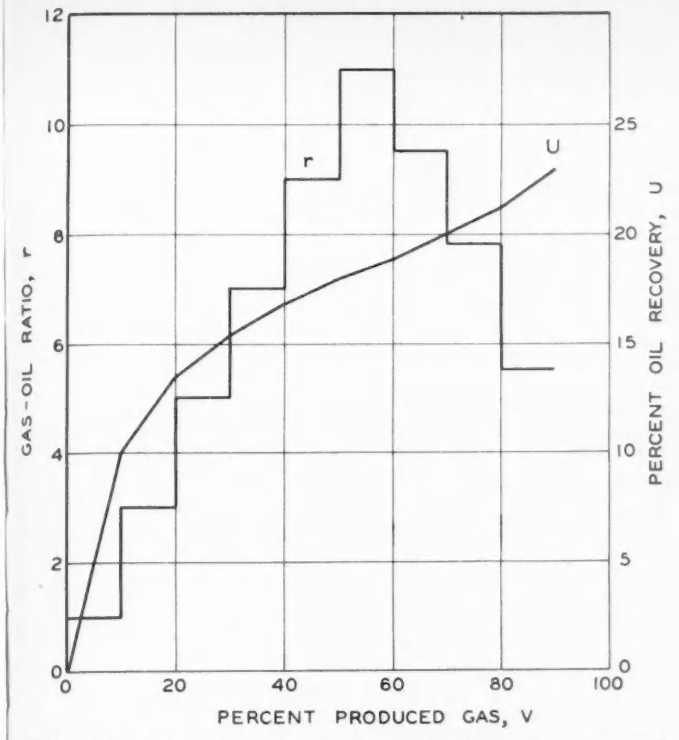


FIGURE 7-4. Estimated oil recovery and gas-oil ratio vs. produced solution gas from an average sandstone reservoir.

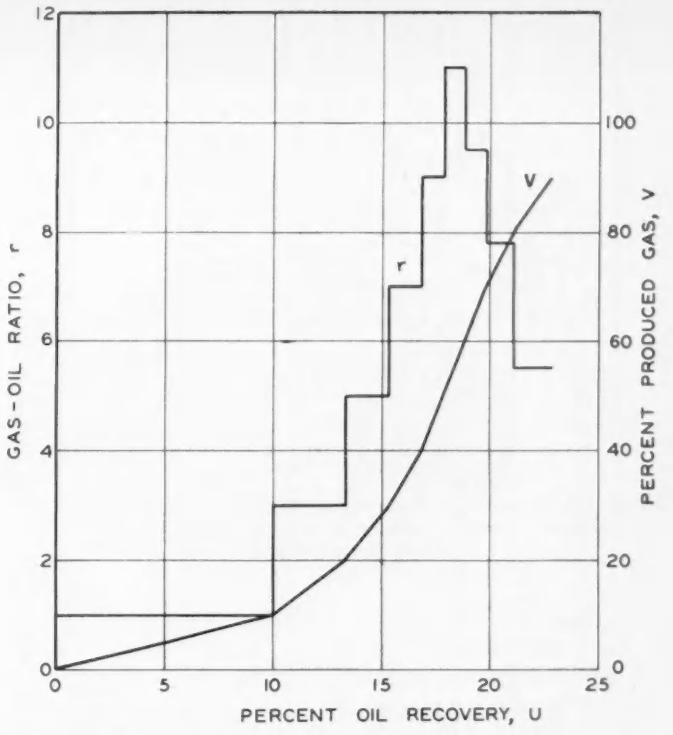


FIGURE 7-5. Estimated oil recovery and gas-oil ratio vs. recovered oil from an average sandstone reservoir.

recovery from a most distant section is on the order of 10-12 percent of in place oil. Allow a 3-5 percent oil recovery by gravity and vaporization, then the highest recovery from most distant sections at low enough pressures is not likely to exceed 15 percent of in place oil.

Suppose oil production from a bed is via the bed into wells; that is, no gas migrates into contiguous beds without displacing oil. For this condition, oil recovery from the sections between a most distant section and a well bore increases from 15 to U_o percent of per-section in place oil. Aside from declining pressure below saturation pressure, the maximum oil recovery U_o at high enough gas-oil ratios is not likely to exceed

$$U_o = 70 - \left(\frac{\mu_o}{\mu_g}\right)^{1/2} \qquad (8)$$

of in place oil for the sections near a well bore.

The viscosity ratio for the oil being displaced increases as pressure declines. On the other hand, at low enough pressures the relative volume of the gas being produced increases faster than a viscosity ratio. At low enough pressures, less gas would be required to realize an oil recovery U_o provided there were no shrinkage of the remaining reservoir liquid. But a declining reservoir pressure is accompanied by a reduction in the volume of the remaining reservoir liquid. The relative volume of the remaining reservoir liquid is b/b_o. At low enough pressures, the volume factor b is on the order of unity and the relative volume of the remaining oil is $1/b_o$ where b_o is the volume factor at saturation pressure.

Aside from any economic limits, the residual oil saturation in the vicinity of wellbores is not likely to be less than the saturation relative to no shrinkage. The latter is $\left[30 + \left(\frac{\mu_g}{\mu_o}\right)^{1/2}\right]$ percent of in place oil. Accordingly, the oil recovery U_w from the sections in the vicinity of wellbores when corrected for shrinkage is not likely to exceed the recovery defined by

$$U_w = 40 + 30\,\frac{b}{b_o} - \left(2 - \frac{b}{b_o}\right)\left(\frac{\mu_o}{\mu_g}\right)^{1/2} \qquad (9)$$

Figure 7-1 is a solution of equation (9). The maximum per-bed oil recovery from the region in the vicinity of producing wells is not likely to exceed 60-65 percent of in place oil aside from declining pressure. The corresponding value corrected for the decrease in volume of the oil not produced ranges from 36-44 percent of in place oil for a volume ratio of 0.4.

Per-Bed Oil Recovery

All the free gas produced by a well passes through the section represented by the face of a well bore. But the circumference of a well bore is very small by comparison with the length of a most distant section or B contour. Hence the convergence of reserve is practically zero for any uniform or random spacing of wells. Therefore the ultimate per-bed oil recovery U is defined by equation (12) in Part 4 as follows:

$$U = \frac{1}{3}\,(2U_b + U_w) \qquad (10)$$

where U_b is on the order of 15 percent for a most distant section and U_w may be 36-60 percent for the section at a well bore, depending on viscosity ratios and shrinkage.

Equation (10) is on a per-bed basis and applies only to the beds which produce oil into wells. The per-bed ultimate recovery aside from gas injection ranges from 22 to 30 percent of per-bed in place oil.

Per-Reservoir Oil Recovery

If gas expands from a less permeable bed into more permeable beds, ultimate

TABLE 7-3

Oil Recovery at 200 psia vs. Gas-Oil Ratio

r	2.0	2.5	3.0	3.5	4.0
R	1134	1418	1701	1985	2268
(R-g)	973	1257	1540	1824	2107
B(R-g)	14.848	19.182	23.500	27.834	32.153
D_r	16.020	20.354	24.672	29.006	33.325
U_r	37.68	29.66	24.47	20.81	18.12

Basis: P_o=2500 psia.; b_o=1.333; g_o=567; T=160° F.
At 200 psia: b=1.172; g=161; Z=0.977; B=0.01526; N=6.037.

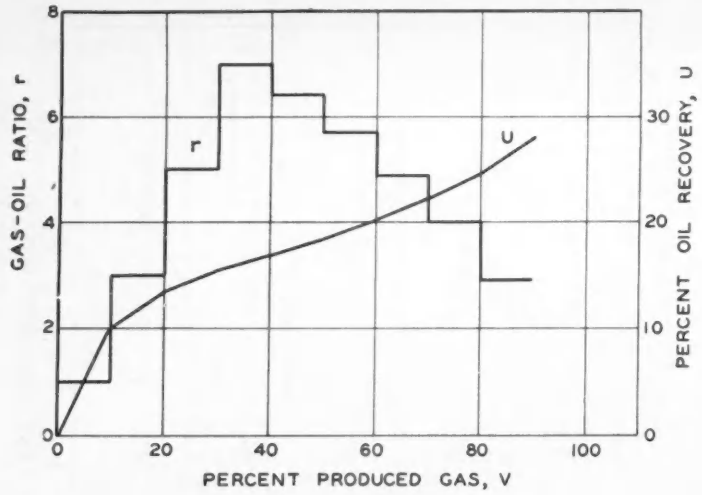


FIGURE 7-6. Estimated oil recovery and gas-oil ratio vs. produced solution gas from a sandstone reservoir having high permeability and gravitational migration of oil.

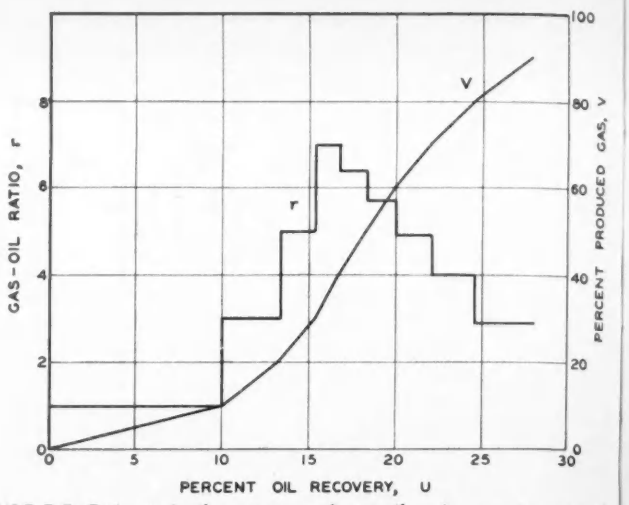


FIGURE 7-7. Estimated oil recovery and gas-oil ratio vs. recovered oil from a sandstone reservoir having high permeability and gravitational migration of oil.

oil recovery may not exceed 15 percent of the in place oil in a less permeable bed. A few fractures or solution channels in a limestone reservoir could bleed of the in place oil in a less permeable Under conditions of extremely high per-bed permeability ratios, the ultimate oil recovery by expansion of solution gas may be only 15 percent of in place oil.

Vertical migration of gas between beds in a sandstone reservoir is nominal by comparison with gas migration through fractures and solution channels. On the other hand, some areal migration within individual beds is inevitable. A 15 percent ultimate oil recovery is for a 100 percent gas migration. A 22-30 percent oil recovery is for no bypassing of oil. But if per-bed permeability varies areally, some gas migrates areally. The average non-marginal oil recovery by solution gas from the sandstone reservoirs studied by the writer was 23.0 percent. The range was 18 to 25 percent.

Oil Recovery vs. Pressure

The relationship between oil recovery and reservoir pressure varies primarily with the produced gas-oil ratio. Figure 7-2 shows the volume factor and gas in solution for a 26.7° API oil. There are 567 cubic feet of gas in solution in one barrel of oil at 2500 psia and 160° F. reservoir temperature. The initial volume factor is 1.33 barrels of space per barrel of oil.

The curves in Figure 7-3 are solutions of equation (3). Oil recovery is plotted against reservoir pressure for gas-oil ratios ranging from unity to five times the 567 gas-oil ratio at saturation pressure. A first 5-10 percent of in place oil is recoverable with a gas-oil ratio on the order of unity. Additional oil recovery is accompanied by rapidly increasing gas-oil ratios.

The gas-oil ratio for oil production by expansion of solution gas varies with per-bed permeability ratios, viscosity of remaining reservoir liquid, gas-oil ratio at saturation pressure, location of producing wells and probably with other factors. As per-bed permeability distribution is not mappable and in view of the numerous factors influencing gas-oil ratios, prospective gas-oil ratios for a given reservoir are not known accurately.

On the other hand, numerous fields covering a wide range of conditions as to properties of fluids, reservoir characteristics and location of wells are already marginal producers. The available field experience indicates at least qualitatively the prospective gas-oil ratios and oil recoveries.

Figure 7-4 illustrates data for a reservoir from which the estimated oil recovery was 22.93 percent at 90 percent cumulative gas production. The gas-oil ratio reached a peak of eleven at 50-60 percent gas production. Figure 7-5 shows the gas-oil ratios and gas production plotted against oil recovery. The peak gas-oil ratio is at about 18 percent oil recovery. These are typical qualitative data for average sandstone reservoirs.

Reservoirs in which permeability is on the order of 1000 millidarcys or higher may have a lower peak gas-oil ratio and a higher oil recovery by virtue of gravitational oil migration. Figures 7-6 and 7 show 28 percent oil recovery and a peak ratio of seven. Most field data on expansion of solution data indicate an oil recovery on the order of 23 percent. The additional five percent in the present example is attribued to gravitational migration of oil at a rate which was significant early enough in the life of the field.

Ultimate Recovery for Injected Solution Gas

The convergence (see Part 4) for gas injection is on the order of unity. So the displacement factor m is given for no shrinkage by

$$m = \frac{1}{2}(U_o + U_b)$$

But for the acre-feet of pay invaded by gas U_b is about equal to U_b and for declined pressure U_o equals the U_w defined by equation (9) and Figure 7-1. Accordingly, m equals U_w and ultimate oil recovery is defined by

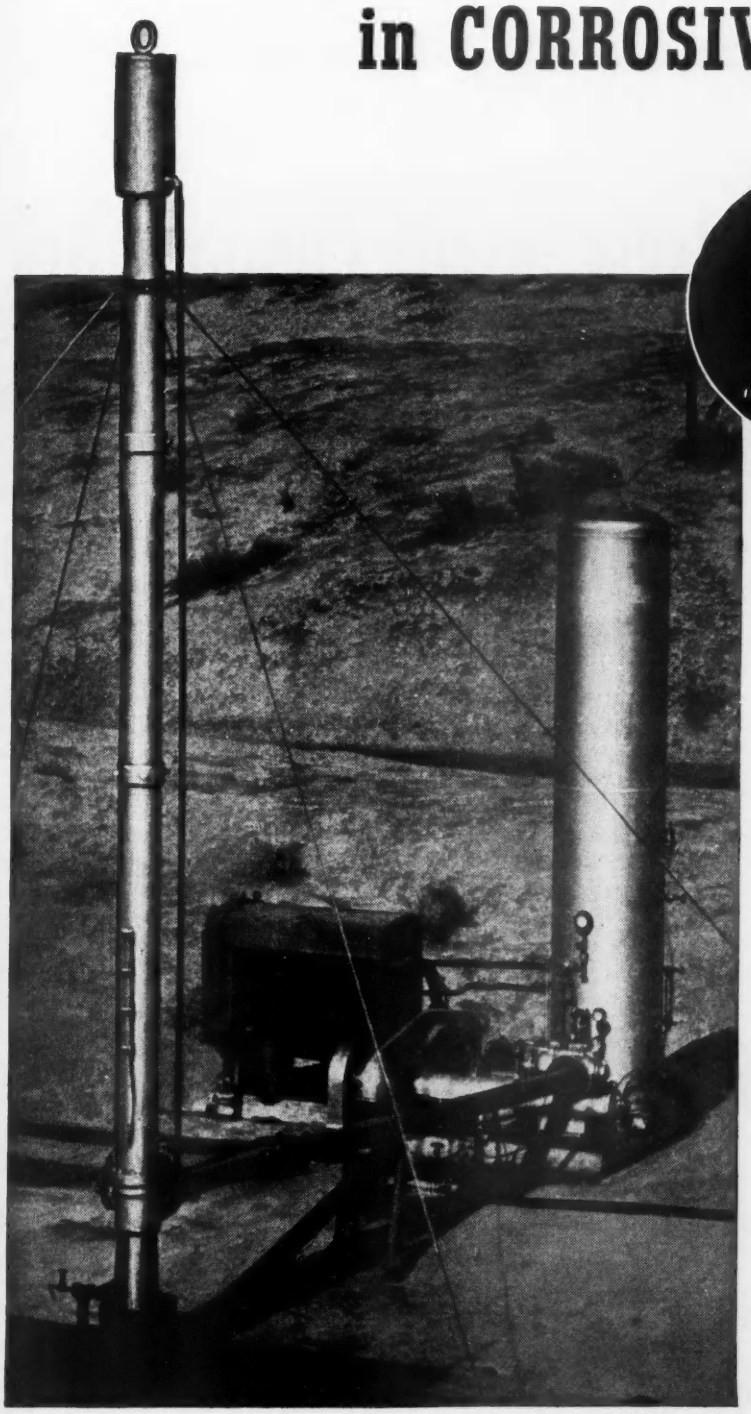
$$U = IU_w + 15(1 - I) \qquad (11)$$

where I is the fraction of oil pay invaded by injected gas, U_w is percent oil recovery from the invaded acre-feet. The oil recovery from the acre-feet of pay (1 — I) not invaded by injected gas is not likely to exceed 15 percent of in place oil.

Suppose the economic limit were 20 Mcf per barrel of oil and the pressure fluid factor were 10,000 at economic limit. By Figure 2 in Part 4, oil recovery is not likely to exceed 54 percent from the invaded acre-feet aside from shrinkage. If the ratio of volume factors b/b_o were 0.8, oil recovery U_w corrected for shrinkage would be [54 — 46(0.2)] or 44.8 percent for the invaded acre-feet. If the latter were 60 percent, the ultimate recovery U would be [44.8(0.60) + 15(0.4)] or 32.9 percent. This value should check the produced gas corrected for injected gas. For instance, if the net gas production were 70 percent of in place gas, the net produced gas-oil ratio would be 70/32.9 or 2.13 times the initial gas-oil ratio.

Figure 4-5 gives a 44 percent oil recovery not corrected for shrinkage. The corresponding oil recovery corrected for a 20 percent shrinkage is [44 — 56(0.2)] or 32.8 percent of in place oil. This value is based on 25 percent displacement efficiency (see Part 4).

How to LOWER LIFTING COSTS in CORROSIVE WELLS



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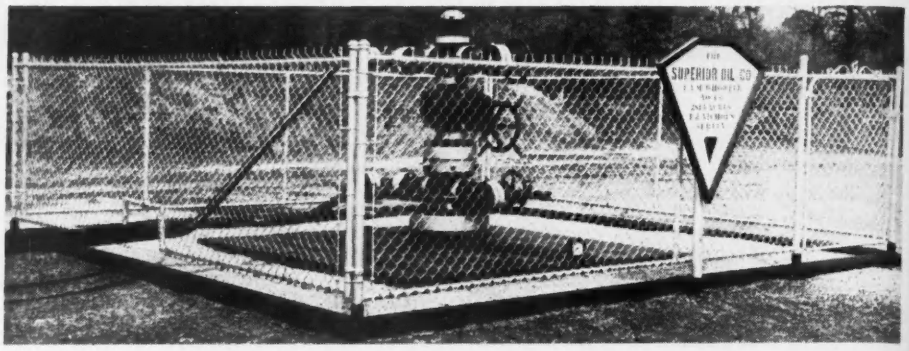
How to do it!

PRODUCTION HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

HOW TO—Install Removable Fence Around Producing Well

From a construction point of view, setting fence post in concrete around a producing well will provide the strongest protection against wandering stock. Disadvantage of such a fence lies in the difficulty in moving it when it becomes necessary to work on the well. Concrete must be broken in removing the fence, and new concrete must be mixed and poured in forms when the workover is complete.



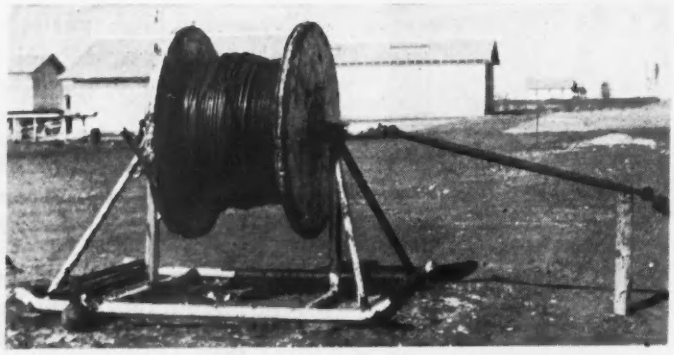
A production foreman in charge of lease maintenance and operation devised a convenient and efficient fence structure which can be easily dismantled when it is necessary to erect a derrick over the well. The well illustrated produces from two high-pressure sands, and a workover is a major operation.

Foundation for the fence is a framework of heavy, discarded pipe, welded into a square of about 20 feet on each side. Midway along one side (at the base of the company sign post in the illustration), the pipe is cut and a shop-made, two-bolt flange is welded to the two pipe sections. A similar cut and flange are added to the opposite side of the pipe framework.

Two-inch pipe nipples were welded at each corner of the frame as well as at the near side of the gate. The 1½-inch main fence supports fit into these nipples and the fence is added. Each side fence section is clamped to the corner posts, and can easily be removed by removing the clamps. The company sign post rests in a short nipple welded to the side of the pipe frame, and is removed by merely lifting it from its socket. When it is necessary to remove the fence, it can be taken down and the site can be completely cleared in short order. Its erection is as simple as its dismantling since it is a matter of removing a few bolts.

HOW TO—Devise Spool to Handle and Store Wire Line

There are some instances in producing areas where wire lines must be removed from pulling equipment or sand line reels and stored in the material yard. This operation requires spooling the wire line from the hoisting drum onto a storage reel such as that shown. Where such line is several thousand feet long, the process becomes tiring if done manually. The spooling device illustrated has served to reduce materially the manual work required in making this transfer.



The conventional reel supplied by the wire line manufacturer upon purchase of the new line is mounted on a skid-type frame made from 2½-inch pipe. The bearing points of the reel axle are adequately supported by vertical members and angle braces which extend to the corners of the skid. The feature that makes this particular unit a time and labor saving device is the axle extension shown at right. To each side of the reel at the center is mounted a flange and axle. On the side shown, the axle extends about 20 inches from the reel flange. An automotive universal joint has been added to the axle and a salvaged truck axle attached. At the other end of the truck axle, provisions have been incorporated for either manual or power winding the reel. It is so designed that a truck can be jacked up on one wheel and that wheel used to power the wire line reel when taking wire rope from either a pulling unit or sand line drum.

A small drag-type brake mounted to the reel opposite the side shown allows the operator to place a small drag on the reel when spooling off into another piece of equipment. In this manner, wire rope can be removed from operating equipment in a minimum of time, or the wire rope can be taken from this storage reel and wound onto the mobile well servicing unit.

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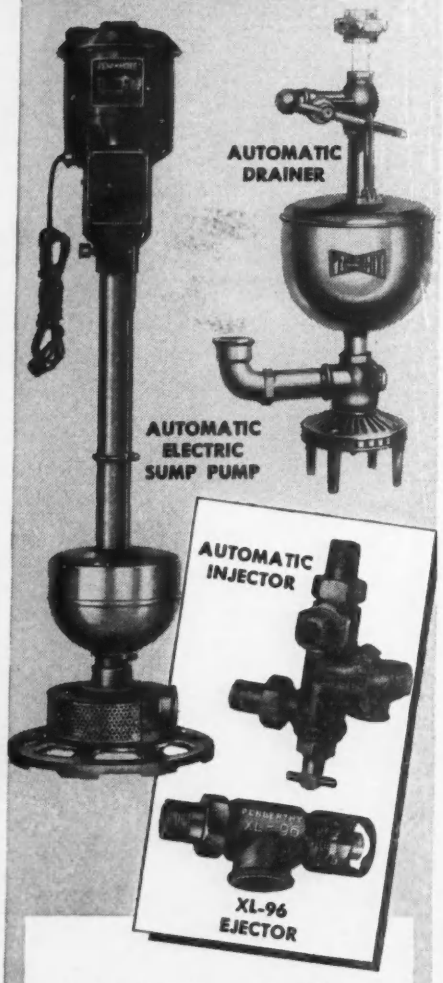

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PRODUCTION HINTS

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The remote control system is inexpensive and relatively easy to install. Laid in the ground before the concrete slab is poured, the line is positioned to permit a near straight-line pull, and from a point that is readily accessible from the road. It is desirable also to have the control handle located in such a position that it can be easily grasped, yet is not so conspicuous as to invite tampering by unauthorized persons.

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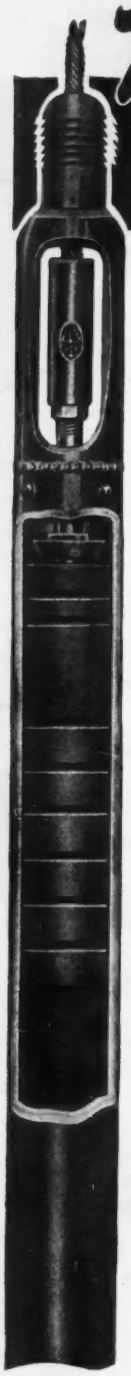

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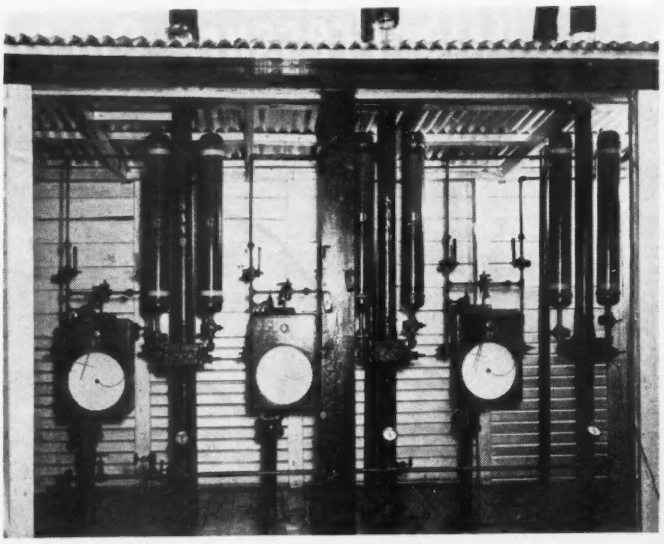
HOW TO—Measure Gas from Triple Zone Well



Triple zone completions in high pressure gas fields are difficult in themselves, but the measurement of the produced gas can be simplified considerably by such an installation as that illustrated. Standardized meter runs were placed in each flow line a safe distance from the well and the measuring equipment was installed in a meter house.

Since the high-pressure gas contains some hydrates and light fractions of hydrocarbons, the meter runs are kept free of liquids by installing them in a vertical position. Each meter run is standardized, being connected into the line by unions which can be seen just above the meter house roof and near the floor.

To reduce the surging of pressure on the meter, and also to keep liquids out of the meter, surge chambers have been added in the upstream and downstream orifice connections. These chambers may be seen on each side of the flow line which is clearly marked to identify its producing zone. The recording meters are separately mounted on individual stands and equipped with high-pressure piping and fittings.

Extending horizontally across the meter runs near the floor of the meter house is a one-inch pipe which serves to bleed the line when it is necessary to change or inspect the orifice flanges. A pressure gauge on each line indicates the pressure. When such an operation is required, the flow line is closed off both upstream and downstream.

wing. The illustration is of a high-pressure gas well producing from two reservoirs and completed as a dual producer. Equipment shown is of 10,000-pound test with the top flow wing producing

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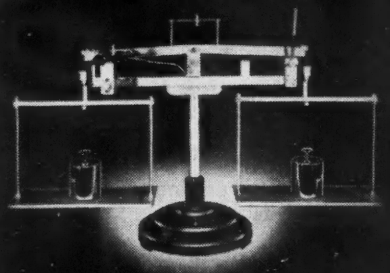

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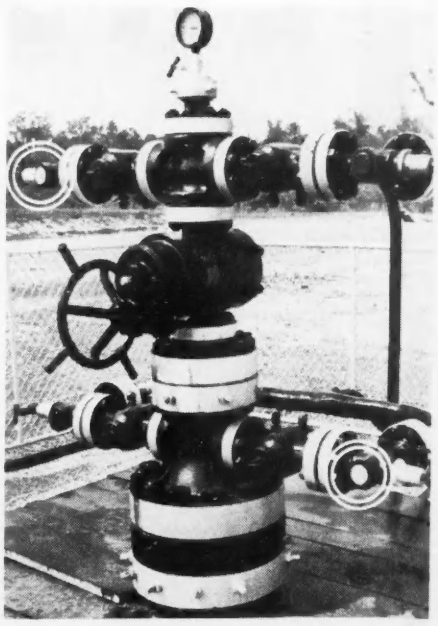
PRODUCTION HINTS

from the lower reservoir and the bottom wing producing from the upper formation.

This particular well head is equipped with two dual-flow wings, each wing incorporating the same type and size equipment. At the bend in the wing, the flow bean adapters have been added, each bean cut off from the well annulus by a high-pressure plug valve. The flow lines from each side of the wing join together on the opposite side of the well head into a single flow line.

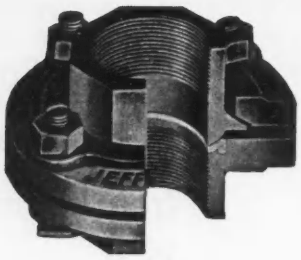
Throughout the producing life of the well, the size chokes must be changed, or the choke replaced due to enlargement of the orifice opening resulting from friction wear of high-velocity gas and gas-condensate. It is quite important that the pumper know, without a doubt, the side of the flow wing from which production is flowing. For new pumpers coming on the job, as well as to keep old-timers informed, the production foreman utilized a color code which is both simple and effective.

The button on the flow bean adapter is painted a brilliant yellow that can be easily distinguished, even at night. These



yellow dots on the flow wing have been encircled and indicate from which side of the wing production is flowing. If the choke must be renewed or the size changed, any pumper will know on which side of the flow wing to make the exchange. This color system is used throughout the field.

Jefferson Malleable Unions



STYLE "B"

JEFFERSON Style "B" three-piece flange union is made with brass-to-iron and iron-to-iron seats. Being made of highly refined AIR FURNACE iron. it assures you of lightweight construction, perfect ball joint, and positive seating arrangement, whether or not in alignment.

★ ★ ★

HYDRAULIC PRESSURE RATING

Sizes	Test Pres.	O. W. G.	S. W. P.-550 Deg.
½" thru 4"	2000#	800#	250#
5" and 6"	1200#	500#	250#
8" and 10"	1000#	400#	250#

Malleable iron used in all JEFFERSON unions meets ASTM 4733, Grade 35018—M. T. 53000 Lbs., giving 75% more elongation 50%-more impact value and is 30%-stronger than cupola malleable iron.

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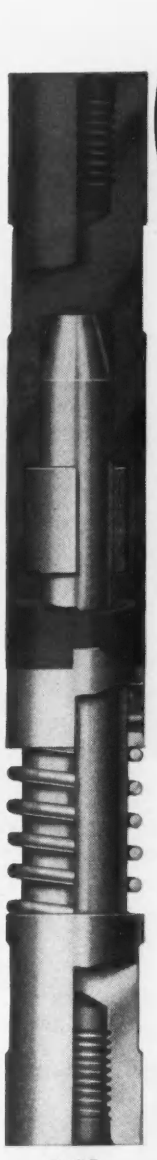
HOW TO— Devise Effective Means of Keeping Cattle Off Lease

Where producing properties, including the well and associated equipment, are not fenced in, and the land owner's stock roam at large, the lease maintenance crew has an added job of keeping the surrounding grounds clean. In an effort to keep the cattle away from the clearing around the producing property, a word of wisdom from an old cattleman was put into practice. The old rancher advised the production crew that most cattle, and particularly Brahmans, exhibited a strong dislike for objects colored red, and suggested that some object near the well be painted red, and further recommended that the object be made to move occasionally.

Illustrated is the outcome of the old ranchers recommendation, and one that, so far, has proved effective. A discarded drum used as the main object was inverted with the open end facing down, and four mutually perpendicular fins were welded to the top side. At the apex of these fins was incorporated a ball and socket joint to which was attached a short piece of light chain. This device was supported about 12 inches off ground by an L-section of 2½-inch pipe framework as shown.

The entire structure was painted a "fire engine" red. Winds keep the barrel in motion and make the device noticeable for several hundred yards away. In an experiment with adjacent leases not equipped with such a device, the production crew reports that so far, the red moving drum has kept the cattle off this particular lease. On the adjacent leases not so equipped, cattle still graze the cleared areas near the well. They did report, however, that an occasional "uneducated" cow will graze near the red barrel, but they feel its installation has more than justified its expense.



PAGE ON & OFF ATTACHMENT

PAGE TENSION TOOLS

Easy engagement
Easy release
A RUGGED
Rod-to-Plunger Connection

THAT'S THE PAGE
SUCKER ROD ON and OFF ATTACHMENT

The Page On & Off Attachment provides a quick, effective means of joining sucker rods to the pump plunger in tubing and casing pump installations. Its proven design permits removal and replacement of sucker rods without disturbing the pump plunger—a foolproof clutch-type locking mechanism eliminates chance for failure even under the severest of pumping conditions.

The success of the Page On & Off Attachment has prompted many operators to switch to larger volume pumps. The result—immediate payout for the changeover through increased production.

SIMPLE CONSTRUCTION—SIMPLE OPERATION!

Simplicity of construction is the keynote of the Page On & Off Attachment. There are no threads to gall, no complex mechanism to foul up. The tool consists of a male and female section which interfit and interlock when the sucker rods are lowered onto the pump plunger. A ¼ turn left rotates shoulders on the male section into milled out slots in the female section. During rotation a locking clutch engages by force of a helical spring positioned below it.

Disengagement of the tool requires only slight up strain and a ¼ turn right. This forces the clutching sleeve down and permits rotation of the female section for disengagement from the male section. Both the male and female sections are milled and turned from solid billits of steel and are held to close tolerances to virtually eliminate chance for wear.

Tear out this page—enclose it in an envelope and mail to Page Oil Tools, Inc., Long Beach, California, for further details.

PAGE OIL TOOLS, Inc.
3356 Lime Ave., Long Beach 7, Calif.

Mid-Continent Distributors
D+B Division—Emsco Derrick & Equipment Co., Garland, Texas
The Continental Supply Company
Dallas, Texas

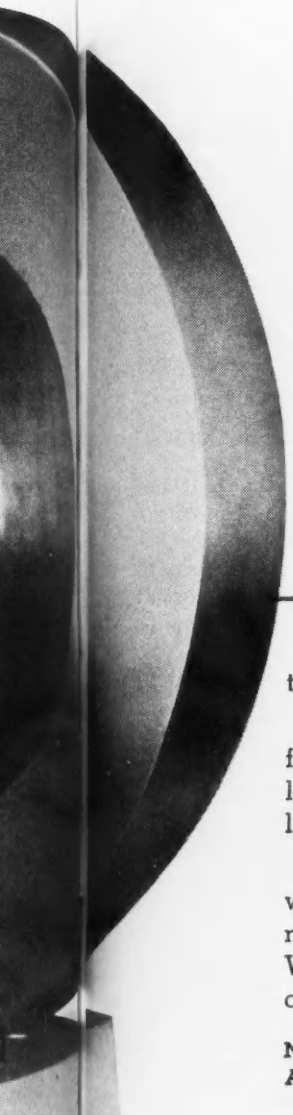
Based on Bearing Performance Records

Westinghouse

says

"do away with lubrication costs"

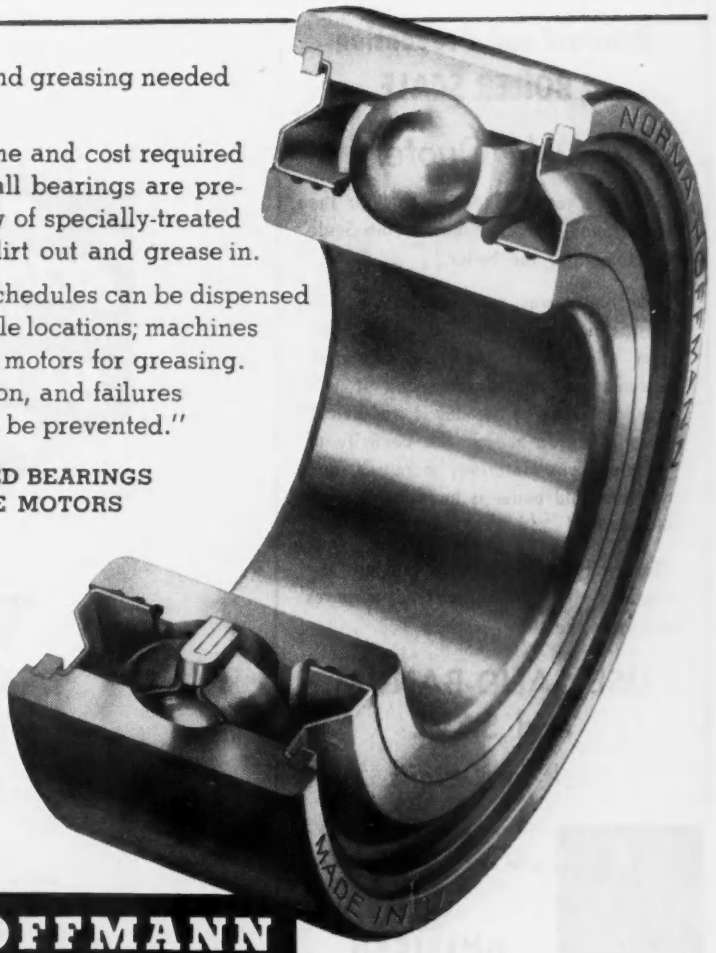
IN THEIR LIFE-LINE MOTORS



"Forget old-time ideas about the care and greasing needed to keep motors running!

"Life-Line motors now eliminate the time and cost required for lubrication. Life-Line double-width ball bearings are pre-lubricated with a more-than-ample supply of specially-treated lubricant — and factory-sealed to keep dirt out and grease in.

"Periodic weekly or monthly greasing schedules can be dispensed with. Motors may be installed in inaccessible locations; machines no longer need be disassembled to reach motors for greasing. Winding failures caused by overlubrication, and failures caused by use of improper lubricants, can be prevented."



NORMA-HOFFMANN "CARTRIDGE" SEALED BEARINGS ARE USED IN WESTINGHOUSE LIFE-LINE MOTORS

With their extra large initial grease supply, made possible by their double width and with highly efficient seals insuring against grease leakage, Norma-Hoffmann "Cartridge" bearings give years and years of service without relubrication. They are prepacked with a carefully metered volume of oxidation-resistant and wide temperature range grease.

Whether you are building motors, machine tools, pumps, fans or other equipment, let our Engineers show you how you may eliminate lubrication costs and simplify your designs by using these "neglect proof" Cartridge ball bearings.

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"This city is noted for having the poorest water for boiler feed purposes of any in the state."

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AMERICAN SAND-BANUM COMPANY, Inc.

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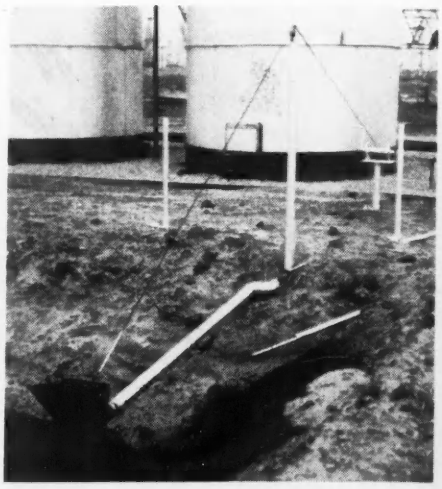
PRODUCTION HINTS

HOW TO— Install Efficient Skimming Device

A sump skimming device which is unusually simple in construction, yet efficient in operation, is illustrated. The intake pan, a triangular container of somewhat more than average depth, is covered with a screen to remove debris from incoming fluid. It is attached to a swivel-equipped pipe, and is raised and lowered by means of a small shop-made winch located some distance back from the sump edge. To provide the necessary vertical lifting motion to the hoisting line, the latter is run up over a small sheave positioned at the top of a vertical eight-foot length of pipe set in the ground with, and midway between the skimming device and the winch. The skimming device, with its wide edge, allows fluid to flow in at an ample rate, and can be raised and lowered in adjustments of only a fraction of an inch, thus permitting the skimming of relatively thin films of oil.



The installation is easily laid out and installed, involving no excavation of the bank or other permanent installations between the sump and the pump. Length of the swing pipe can be varied to suit the installation to any depth sump or slope of bank.

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Standco NO-SMOKE BRAKE LINING

Standco Brake Blocks are made of cabled cords of long fibre asbestos — woven solid and reinforced with bronze wire to prevent pulling loose on the belts. They will not burn or smoke or score brake rims.

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Passage of radioactive material is signalled by clicks from the Geiger counter held against the pipe.

Radioactivity in Pipe Line Flow Studies

By D. E. HULL, J. W. KENT and R. D. LEE
California Research Corporation, Richmond, California

EXPERIMENTS have been carried out recently to demonstrate a novel application of a by-product of atomic energy to the tracing of fluid flow through pipe lines. The results of the testing carried out thus far show that it is feasible to label with a small quantity of radioactivity the interface between two different crude or refined product stocks in a pipe line and to detect that interface at a later time and at a point far downstream. This permits operating personnel to switch more exactly the flow in a pipe line as the different fluids appear at a pumping station, refinery, or terminal. It also makes possible accurate and instant evaluations of the mixing en route of two adjacent stocks in a pipe line. Fundamental studies of flowing liquids, measurement of velocities, and volumes can all be accomplished quickly and easily by the radioactive tracer technique.

Experiments utilizing this technique have been performed by personnel of California Research Corporation, a subsidiary of Standard Oil Company of California, in a 5.1-mile stretch of 20-inch pipe line owned by Standard. The radioactive material used in the test was purchased from the Isotopes Division of the Atomic Energy Commission at Oak Ridge, Tenn. This radioactive material consisted of 10 millicuries of radioactive barium (Ba^{140}) in a dilute solution of hydrochloric acid.

The decay scheme of radioactive barium is shown on the next page. The gamma rays associated with radioactive lanthanum (La^{140}) are more penetrating than those of the Ba^{140} and comprise the radiations actually measured in these experiments. In fact the La^{140} gamma rays are sufficiently penetrating to permit the measurement from outside the pipe of any La^{140} contained inside the pipe.

TRACING OF stocks and stock interfaces in pipe lines with a radioactive uranium fission product offers a means for "seeing" within the line during operations, and a means for accurately determining the arrival of an interface at any given point. The method also provides an accurate means for tracing the spread of the contamination at the interface. Proper handling of the radioactive material eliminates hazard to personnel or consumer.

After receipt of the radioactive barium, it was converted to an oil-soluble barium soap and this compound was dissolved in a small quantity of oil. This oil containing the radioactive barium was then injected into a crude stream in a 20-inch pipe line on the upstream side of a centrifugal pump. Apparatus used included a cylinder of compressed air at 100 pounds per square inch which drove the oil into the pipe. A quart of kerosine was forced in behind the radioactive sample to flush it out of the valve. The injection required about three seconds.

Detection of the presence of radioactivity was accomplished with a portable Geiger counter. With this instrument the counts could be heard through a pair of earphones and the counting rate (counts per minute) could be read from a dial on the front of the instrument.

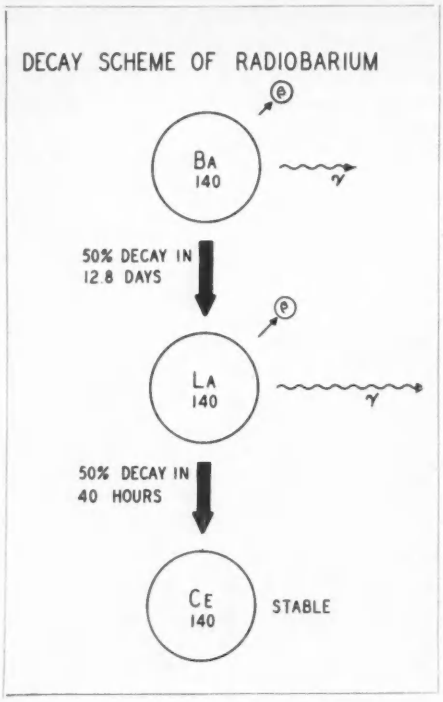
One of the most valuable measurements in these experiments was the determination of the extent to which the radioactivity spread during its travel through the pipe line. This spread of the radioactive "wave" was easily meas-

ured with the portable counter at four points between the place of injection and the terminus.

The results of these experiments show that in a pipe line connecting two points, with no booster pumps or surge tanks between the two points, there is a significant blurring of the interface between two stocks. Thus the spread of the radioactive wave increased about 50 percent during a journey of five miles. This result leads one to believe that one of the valuable applications of this radiotracer technique will be the determination of the degree of intermixing of two consecutive stocks flowing through a pipe line.

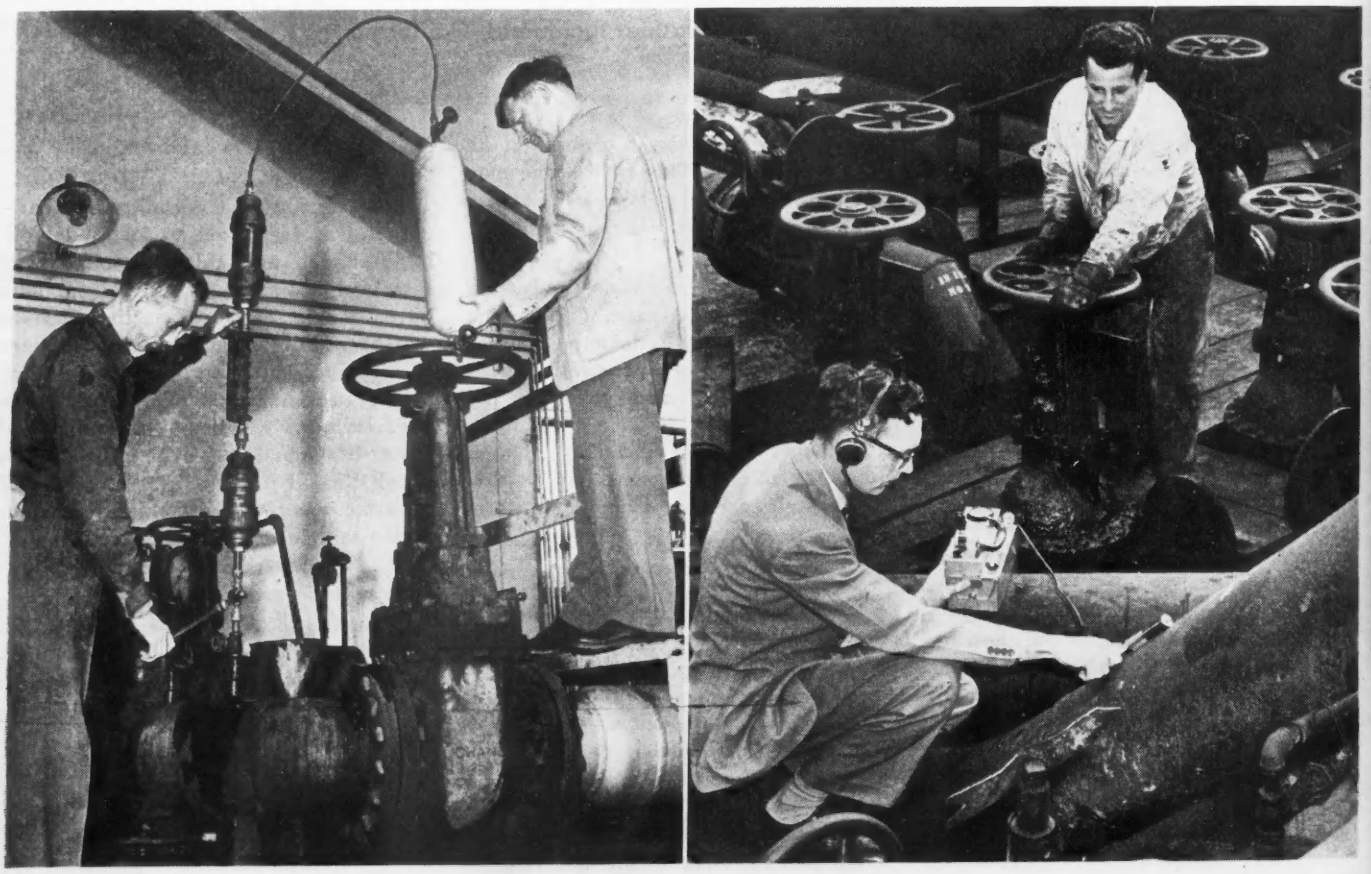
One millicurie of radiobarium, costing less than $3, is sufficient to label an interface for the test described. Only a few hours were required for a radiochemist to synthesize the oil-soluble radioactive barium compound. It is interesting that an equivalent amount of radium (one milligram) would cost $20. The counter equipment used to detect the radioactivity is relatively inexpensive, and is quite rugged and reliable. Indeed, the first test was carried out in a light rain.

Many schemes have been proposed for applying this technique to pipe line operations. In routine use the output of the Geiger counter could be fed into a recording meter, and the arrival of a radioactive wave could serve to flash a light, sound a warning bell, or even to operate valves automatically. If preliminary warning of the arrival of a stock were desirable, a counter could be strapped to the pipe several miles upstream and the signals transmitted to the terminal station.



Extensive measurements and calculations have been made to make sure that the radioactive material added to the pipe line stock could not cause any radiological hazard whatever to the health of refinery employes or consumers of the refined products. The chemical preparation of the barium compound does involve a potential hazard, but this has been avoided by use of standard techniques for handling radioactively "hot" materials. After use of the tracer in the pipe line, its dilution and subsequent decay during storage and refining operations attenuate the activity so greatly that it cannot be distinguished from the cosmic ray level with a Geiger counter.

It is therefore believed that this radioactive technique provides a practical method of obtaining valuable information on the location, flow velocity, and degree of intermixing of stocks flowing in a pipe line, and that it can also lead to a clearer understanding of what occurs inside a pipe line containing flowing liquids.



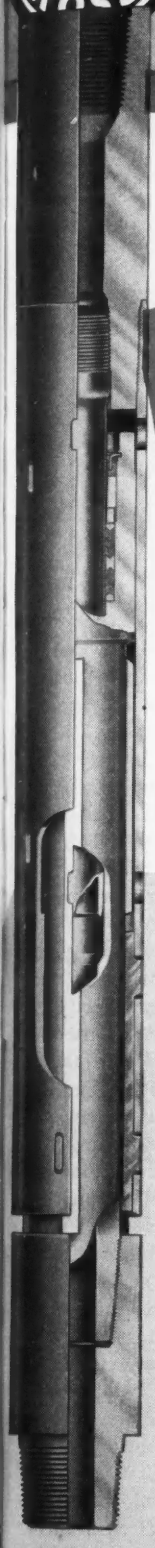
LEFT: Injecting tracer into pipe line. When the gate valve is opened by the engineer on the left, an oil-soluble radio barium compound just above the valve is forced into the line by the pressure of air in the tank at the upper right as a new stock is being turned into the pumps.

RIGHT: New stock arrives at refinery. When the counter indicates the arrival of the stock interface at the refinery terminal, the valve is turned to switch the new stock into the proper tank.

Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HOUSTON • OKLAHOMA CITY • NEW YORK

OUR 29th YEAR



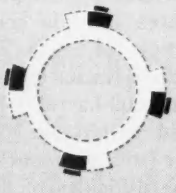
Here's the kind of RUGGED CONSTRUCTION you need for SUSTAINED OPERATION on today's drilling operations!

The BAASH-ROSS DRILLING TYPE BUMPER SUB

THERE'S A LOT OF DIFFERENCE IN BUMPER SUBS—particularly in the internal construction and provision for long sustained operation under the most rugged of modern high speed drilling operations. As its name implies, the Baash-Ross *Drilling Type* Bumper Sub is specially engineered for rough and tough drilling applications . . . specially engineered to *stay on the job* for run after run with minimum maintenance and attention.

Moreover, its simple design and construction eliminates complicated mechanisms and assures quick, direct operation whenever its protection is needed. It can be used to strike both *DOWN* and *UP* blows with equal effectiveness!

AMPLE RADIAL DRIVE



Here's a vertical cross-section view of the Baash-Ross Drilling Type Bumper Sub. Note the ample number of drive keys equally spaced around the circumference of the tool . . . plenty of keys to transmit all the torque the drill string can handle—and to withstand heavy vibration and rough drilling.

. . . PLUS LARGE VERTICAL SURFACE

Coupled with the ample number of radial drive keys is the extra long vertical length of each drive key, as shown in the accompanying illustration. Not only are there plenty of drive keys spaced radially around the tool, but each key is unusually long so as to provide more than enough contact area for all types of drilling loads. Because torque loads are distributed over a greater surface, wear and abrasion are minimized and maintenance is reduced to a minimum.

Replaceable Bronze Inserts LENGTHEN LIFE

In addition to the unusually large drive surface provided by the ample number of radial drive keys and their long vertical length, here's another important Baash-Ross feature . . . each drive key is so designed that the drive surface can be completely renewed by simply replacing removable bronze inserts—a quick and easy operation.

These bronze inserts not only provide the longer life of bronze against steel contact, but being softer than steel they take whatever wear does occur. Thus, by simply replacing the bronze inserts at periodic intervals, the Drilling Type Bumper Sub is easily maintained at peak operating efficiency throughout many thousands of feet of heavy-duty drilling service.

Easy to Use—And Many Uses!

- The Baash-Ross Bumper Sub will strike either a down or up blow to loosen stuck pipe, reamers or bit. Down blows are struck by dropping the drill string straight down, while up blows are struck by "springing" the drill string when the Sub is partly open, thus striking a sharp blow on the up stroke. Both types of blows are easy to strike and their intensity can be readily controlled as desired.
- The Drilling Type Bumper Sub can be placed wherever desired in the string—above bit, reamer or drill collars. Many operators also use it to provide a "free joint" in the drill string between tension and compression zones, thus assuring more accurate weight control.
- In addition, this Bumper Sub can also be used in any type of fishing operation, further increasing its all-around utility!

PACKED OFF FOR HIGH PRESSURE CIRCULATION

Still another important Baash-Ross feature is the high-pressure packing unit between mandrel and sleeve that permits very high circulation pressures to be maintained through the Bumper Sub without leakage. Whenever necessary, the packing can be easily inspected, tested and replaced right on the rig.

Also, note the large circulation passage through the tool that not only permits full volume circulation to the bit, but also permits running wire line tools through the Bumper Sub without risk of hanging up.

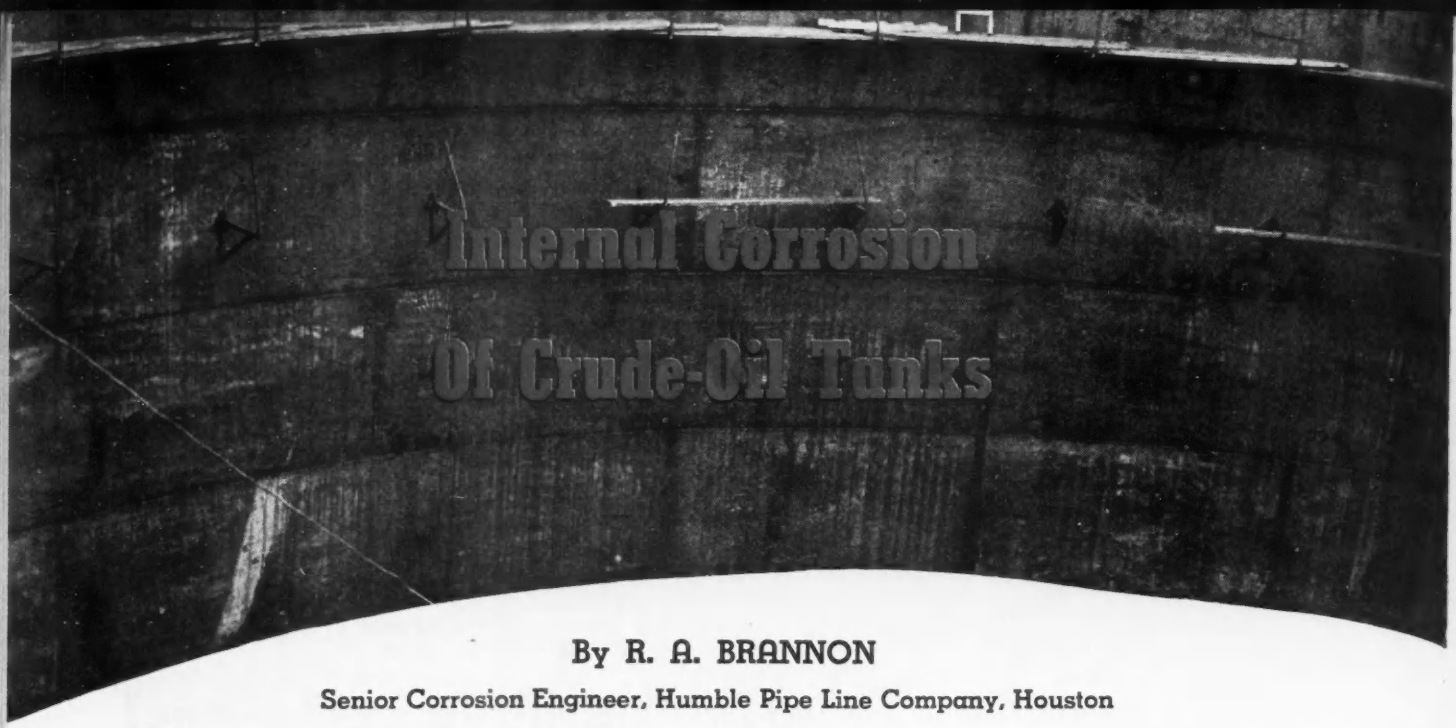
From every angle, this tool is designed and built to meet the vital requirements of *sustained operation* in modern drill strings!

AVAILABLE IN ALL POPULAR SIZES

The Baash-Ross Drilling Type Bumper Sub is available in a complete range of sizes to fit Regular, Full Hole and Internal Flush drill strings from 3½" through 6⅝"—for both Left and Right Hand strings. Standard stroke is 16", but other strokes can be supplied on order.

Write direct for full details—or see your nearest Baash-Ross representative!

(Leased in U.S.A.—Sold for Export only)



Internal Corrosion Of Crude-Oil Tanks

By R. A. BRANNON

Senior Corrosion Engineer, Humble Pipe Line Company, Houston

SOUR CRUDES, those containing hydrogen sulfide and other sulfur compounds, are extremely corrosive inside tanks with most of the damage occurring on tank bottoms where salt water settles and in the vapor spaces where moisture condenses. The author, in a paper originally presented at a Division of Transportation Symposium on Pipe Lines at the annual API meeting, Chicago, discusses protective coatings and their relative efficacies, and recommends measures which should add greatly to tank life in such areas as West Texas.

INTERNAL corrosion of crude oil tanks varies widely in degree, depending upon the nature of the oils contained in or handled through them. Crude petroleum oils may be divided, insofar as their corrosiveness is concerned, into two broad groups. These groups are sweet crude and sour.

Sweet crude contains no dissolved hydrogen sulfide and relatively small amounts of mercaptans and other sulfur compounds. Corrosion of tanks handling these oils is usually a minor problem, as it is confined principally to the tank bottoms where salt water settles. It is a relatively simple matter to apply protective coatings to the tank bottoms to prevent this corrosion. Fortunately for the pipe line companies, most of the crude produced falls into this group.

Sour crude oils contain hydrogen sulfide and sulfur and other sulfur compounds in varying amounts. These oils are corrosive to tanks in varying degree, depending upon the amount of sulfur and sulfur compounds present as well as such other dissolved or suspended matter such as salt water, iron sulfide, and other substances. It appears that the corrosion rate is affected not only by the presence of the individual corrosive agents, but also by the various compounds in which they occur.

The API Sub-committee on Internal Corrosion of Crude Oil Pipe Lines and Tanks is at present making a survey of the industry to determine which fields produce corrosive oils and the extent to which they create corrosion problems among the pipe line companies. My own knowledge of this problem is restricted largely to Texas. The sub-committee has received reports that oils produced in the McKamie and Magnolia fields in southern Arkansas contain high concentrations of dissolved hydrogen sulfide, and are quite corrosive. General reports have been received showing that corrosion is rather severe in the case of oils produced in certain western Kansas fields. More complete information is needed regarding these and other areas where internal corrosion of tanks is being experienced.

Corrosive Oils Vary

In Texas large quantities of corrosive crude oil are produced in West Texas. Some of the smaller fields, such as Sugarland on the Gulf Coast, also produce extremely corrosive oils. It has been found that the corrosiveness of the oils varies widely between different fields in the West Texas area and that there is a wide variation within the individual fields, and even between adjacent wells. It has also been noticed that corrosiveness varies with time, and that this change is apparently due to changes in composition of the oil produced. For instance, when a well begins to produce appreciable quantities of salt water, the corrosion rate of lease tanks is greatly increased.

Tank bottoms are quite seriously corroded due to settling of salt water and to settling of scale which is pumped into the tanks with the oil or which falls from the roofs of the tanks. The corrosion of tank bottoms and the lower portion of tank shells which are exposed to salt water is probably more general throughout the area than is corrosion of the other portions of tanks. The severity of this corrosion varies widely. There are reports that 500-barrel bolted lease tanks have failed within six months. Service lives range from six months up to several years. The difficulty of determining the average service life of tank bottoms is illustrated by an example where an employe of an oil company gave the information that untreated tank bottoms at a certain battery would last six months; whereas another employe at this same battery estimated the life at four years. Because of the wide variation existing at the various tank locations, it is impossible to measure even approximately the average corrosion rate in inches of penetration per year.

The vertical surfaces of tank shells and columns which support roof structures are not seriously corroded, as a rule, in the area where they are used continuously or periodically submerged in oil. Severe corrosion is usually limited to the vapor space in the upper portion of the tank, and in the lower portion where water settles from the oil. Tank roofs are corroded where dissolved hydrogen sulfide evaporates from the oil into the vapor spaces of tanks. Water vapor condenses from the air contained in tanks,

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1. Water Industries
2. Natural Gas, Crude Oils and Products Transmission
3. Professional Application in Plants and Yards
4. Distribution Systems
5. Reconditioning Operations
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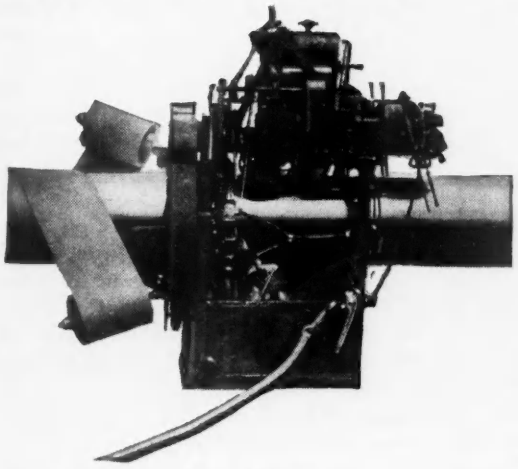
Materials and Application Procedure for NATURAL GAS, CRUDE OILS AND PRODUCTS TRANSMISSION



This machine is applying Barrett Pipeline Enamel and wrapping asbestos felt.

Because of the variable weather conditions under which enamel is applied to pipe, it is necessary to have a *weatherized* primer.

Most primers are designed to dry under normal conditions (50% humidity at 70°F) during 9 months of the year, but Barrett also makes special primers for use in very cold and very hot application weather.

These primers form lasting bonds with all Barrett* Enamels. Thus the line engineer is offered a wide range of primer-enamel combinations to suit his particular construction conditions.

The application of hot enamel over the primer *re-softens* the primer, and causes it to fuse with both the metal and the enamel for a perfect bond.

The initial and sustained dielectric values of Barrett enamels remain unchanged under all normal line currents. Since these values do not break down under electric currents put on the pipe, the economy of cathodic protection is assured.

The Barrett organization will be glad to confer with you on any of your pipe coating problems.

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and is deposited on the metal surfaces in the form of liquid water. Hydrogen sulfide is dissolved in this water, and corrosion of the steel proceeds at a rapid rate. A surprisingly large amount of water is condensed in the vapor spaces of tanks, even in areas where the humidity of the atmosphere is quite low. The water also remains on the roof structures a large proportion of the time, as it appears that the steel must reach high temperatures in order to evaporate the water which has condensed on it. The vapor spaces of tanks are more severely and more generally corroded than other portions. Measures for preventing this corrosion have been less successful than have the measures employed for protection of tank bottoms.

Economics of Corrosion

The cost to the pipe line industry of internal corrosion of crude oil tanks cannot be estimated with accuracy, but there is no doubt that the economic losses are tremendous and that the problem deserves considerable study. It is likely that conditions will become worse instead of better with the passage of time, as increasing age of producing oil fields usually leads to the production of larger quantities of salt water along with the oil. It is also likely that the handling of sour crude will be extended to additional trunk line systems which have been in sweet crude oil service exclusively.

The remedial measures which have been employed have been quite varied in their nature, but until recently have been rather uniform in their results in that they fail to provide satisfactory protection to tanks, especially in the vapor spaces. The remedy which one naturally thinks of first is the application of a protective coating. Accordingly, a number of paints and other preparations were tried several years ago—with results which were generally discouraging. Although it was possible to apply coatings to the bottoms of the tanks and thus greatly increase their service lives, it was found that none of the coatings available would remain in good condition in the vapor spaces for a sufficient length of time to add greatly to the service life of the tank roofs and the upper portion of the tank shells.

Upon finding that the protective coatings were of doubtful value, it was logical that attention should be turned to the use of materials other than steel for the construction of tanks. In the case of small tanks up to 1000 barrels in capacity, a reasonably satisfactory subsitute was found in the use of wood tanks. Tanks constructed of wood have been, and are being, widely used in areas where internal corrosion is severe. They have obvious disadvantages even in the smaller sizes, however; and no doubt all users of them would be glad to find a more satisfactory construction material.

Some use has been made of tanks constructed of aluminum; and it appears that this material is suitable for tank construction, especially in the roof and upper portions where there is no danger of contact with salt water. It appears that, in the future, the use of aluminum in tank construction will be limited to roof plates, roof structural supports, and possibly the upper ring of tank shells. With the recent increase in steel prices, the cost of aluminum roof plates and roof structural supporting members compares more favorably with the cost of steel roofs. The cost of aluminum roofs in the case of large tanks is reported to be about 1½ times that of steel. When the savings to be made by eliminating the need for painting the outside of such roofs is considered, they become economically competitive—with only a small increase in life due to superior resistance to internal corrosion. Some proponents of this type of roof believe that the service life will be at least doubled, and may be extended to as much as 40 years.

Tank Bottom Protection

In the case of tank bottoms, a substitute material in the form of a solid concrete floor has been, and is being, widely used. This consists of a reinforced concrete slab, approximately six inches thick, which is poured onto the grade inside the tank shell. It is made oil-tight by increasing the thickness near the shell to approximately one foot and by caulking a V-shaped groove between the edge of the concrete slab and the tank shell by means of oakum or other packing material and coal tar-base plastic material. These bottoms are mainly used in replacing bottoms which require replacement because of corrosion in existing tanks. Inasmuch as these bottoms cannot be salvaged, they can be economically used only at tank locations which are considered permanent. They are usually installed over the old steel bottom, but may be installed directly on the grade with only sketch plates under the shell to support its weight. The cost of one of these bottoms for a 114-foot-diameter tank in Texas ranges from $5800 to $6200.

Inside the Tank

The protective materials which have been tried and used for protecting steel surfaces inside of tanks are many and varied. Galvanized steel has been rather widely used in the case of bolted tanks, and it appears that the extra cost of this zinc-coated steel is justified in areas where the corrosion is severe. The extension of service life is still not great enough to be satisfactory to most users of these tanks. Various other metallic coatings have been tried, such as lead applied by dipping, and aluminum, zinc, lead and possibly other metals applied by spraying the molten metal onto the steel surfaces by the metalizing process or other methods. There has been little success with these coatings, and their use has been quite limited.

Bituminous coatings have been quite successfully used in coating tank bottoms. These coatings consist of a primer and an application of the bituminous material which is usually melted and spread over the surface by pouring or brushing. In some cases sand or other inert material is incorporated in the bituminous coating to form a mastic which has greater resistance to moisture absorption and to distortion by physical forces. Asphalt-base bituminous materials are sometimes used. These materials have the disadvantage that they are soluble in oil, and they require that a layer of water be carried in the tank to prevent contact between the oil and asphalt. It is difficult to obtain adequate protection to the tank shell with this material at the oil-water line where corrosion is likely to be unusually severe. Other bituminous materials have a coal tar base, and they are less subject to solution in oil. Usually no effort is made to prevent contact of these coatings with the oil, but settling of water naturally present in the oil sometimes provides this separation.

Several coal tar-base coatings with special ingredients have been developed by various suppliers of protective coating materials and offered for use on tank surfaces exposed to crude oil vapors.

About the Author

RUSSELL A. BRANNON was born in Merit, Texas, December 22, 1902. He studied chemical engineering and business administration at the University of Texas, where he graduated in 1928 with a B.A. degree in business administration. He joined Humble Pipe Line Company in 1928 as chemist, working on water-treatment and corrosion problems. He is now senior corrosion engineer and an administrative assistant. He was the first president of the National Association of Corrosion Engineers, 1944-46.

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Some of them have been rather widely used on tanks of all sizes. Indications are that these coatings give full protection to tank roofs for periods ranging from a few months to five or six years. There is considerable evidence to indicate that the destruction of the roof metal is retarded even after the coating shows definite signs of failure.

Probably the greatest hindrance to the more widespread use of these materials has been the high cost of preparing the metal surfaces and applying the protective coating. These coatings, in common with all others of which we have knowledge, require that steel surfaces be cleaned by sandblasting or equivalent methods for removal of all scale and foreign material and for providing a roughened surface for better adhesion of the paint films. Before 1940 the complete cost of such coating closely approached the cost of the steel tank roofs themselves.

During the past few years several paints have been developed which exhibit properties indicating that they can be successfully used for protecting these steel surfaces. Synthetic plastic coatings which are insoluble in crude petroleum oil and which can be applied with few microscopic pores have been developed. Several oil companies are now using these coatings as a regular practice on lease tanks in West Texas. Most of these tanks are of the 250- or 500-barrel size. These companies are also participating in a cooperative effort to determine the effectiveness of the various coatings. Annual inspections are made, and representatives of other companies and anyone interested are given an opportunity to observe the coatings. An attempt is made to arrange the production operations in such manner that as many different coatings which have been subjected to as many different conditions as possible are available for inspection. These tanks provide the ideal testing ground for various materials and methods of corrosion prevention, because the tanks are small and have relatively short service lives unless protective measures are employed.

The 1948 inspection was conducted September 14-16, and was sponsored by the Midland Section of the National Association of Corrosion Engineers. It was my observation during this inspection that plastic coatings afford good protection for periods of one to two years. Some evidence of failure, such as the presence of small blisters, is usually present after one year; but usually there is no sign of metal attack under these coatings even at points of failure, and there is no doubt that the service lives of the tanks will be very greatly extended. In some cases the plasticizer incorporated in the paint has been leached out by the hydrocarbon vapors, with the result that the paint film has become brittle and has lost its adhesion to the steel. No doubt further study of this problem by the paint manufacturers will result in improvements of the paints.

One of the coatings inspected consisted of extremely finely-divided metallic lead which had been dispersed in a vehicle consisting of a small amount of plastic paint and a thinning agent. This material was applied by spraying to sandblasted surfaces in much the same manner as any quick-drying paint or lacquer. It appeared to have good resistance to the action of salt water on tank bottoms and to the action of liquid crude oil. In the vapor spaces it showed blisters similar to other paint coatings.

The cost of almost all of these paint coatings, including preparation of the metal surface, application of the paint, and the paint materials, is about 30 or 35 cents per square foot of area covered.

It is especially apparent in coatings such as these, which show signs of failure after relatively short periods of service, that proper cleaning and preparation of the metal surfaces and the use of proper methods of application are the principal factors in determining the performance which can be obtained from a protective coating. It has often been said that coating performance is based 90 percent upon application and 10 percent upon materials. It appears that, in this case, both application and material must be almost perfect in order to provide satisfactory service. Much better results can also be obtained when coatings are applied to new steel than when the same coatings are applied to steel which has been exposed to sour crude. It appears to be practically impossible to remove completely all the corrosion products or absorbed material in the case of steel which has suffered corrosive attack by these oils.

Gunite Coatings

The protective covering which appears to have been most effective in preventing internal corrosion of all portions of tanks of all sizes is one consisting of reinforced Portland cement mortar applied by means of cement guns. This application process is referred to as guniting, and the coatings are referred to as gunite. Gunite coatings have been used for many years on the Gulf Coast by refineries and pipe line companies for protecting the inside of tanks and other vessels. The results have been rather uniformly satisfactory. The metal surfaces are cleaned and prepared for application of the gunite coating by sandblasting to remove scale and to roughen the metal surface. Reinforcing steel is attached to the roof and shell by tack-welding one-fourth-inch rods on 18-inch to two-foot centers. A covering of 3 by 3 inch 10-gauge wire mesh is then attached by means of tie wires to these rods over the entire surface. Rafters and other roof-supporting structural members are wrapped with the wire mesh so that they can be completely covered with gunite. In tanks where welding is not allowed, the reinforcing rods are attached to the roof and shell by means of clips riveted to the steel plates. Similar reinforcing is placed on the bottom of the tank, except that it is not attached to the bottom. During application of the gunite the steel mat, consisting of rods and mesh, is lifted off the bottom so that it is placed in the center of the gunite layer.

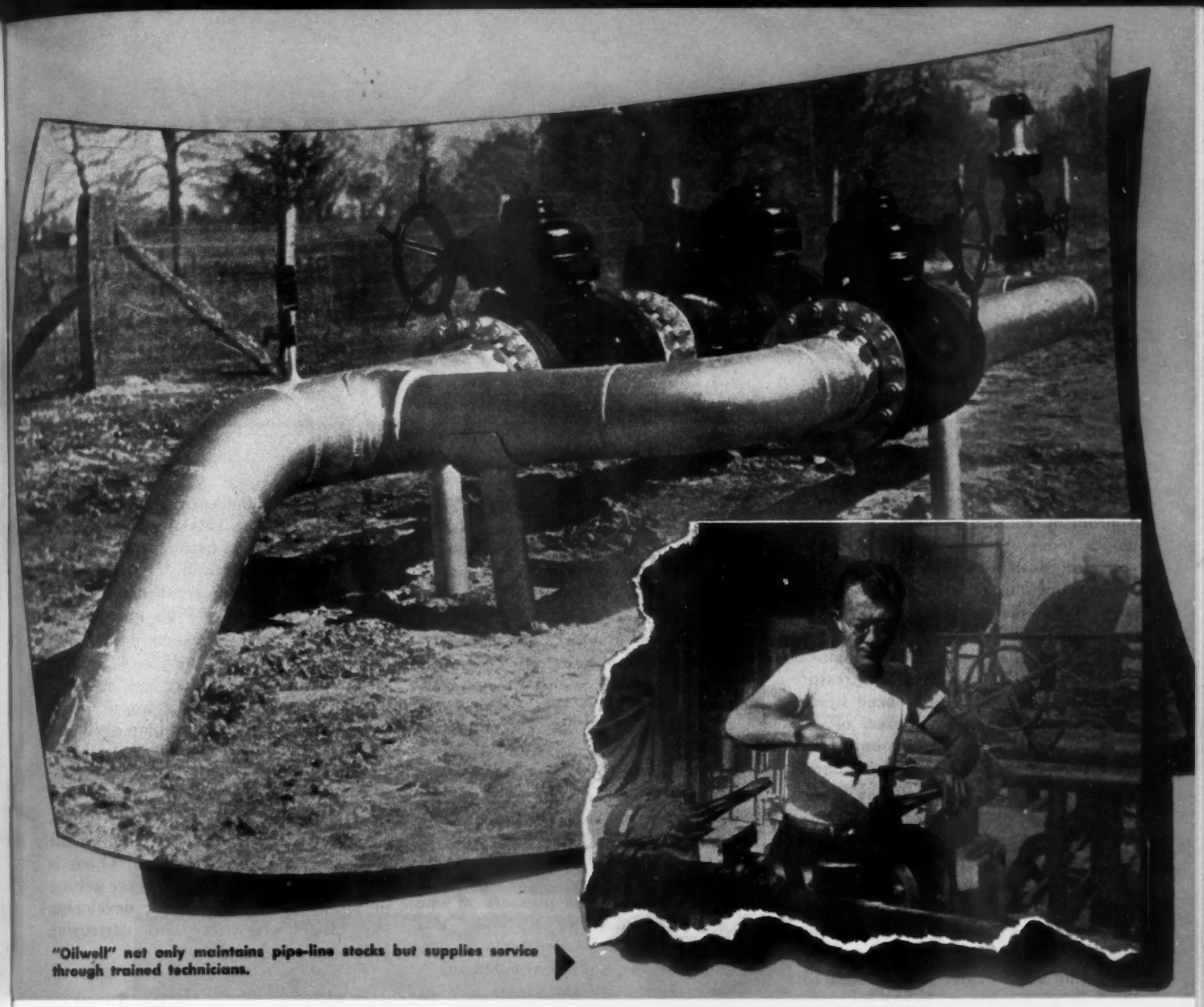
Typical specifications for guniting provide that the cement mortar shall consist of a mix of one part Portland cement to three parts sand, and that air pressure for guniting shall be 65 pounds per square inch, minimum. The minimum thickness of gunite usually specified for the shell is one inch; that for the roof is 1¼ inches; and that for the bottom is two inches. The gunite is cured by keeping it wet for a minimum of 48 hours and, where necessary, moist steam is used in the tank to maintain temperatures high enough for effective curing during the 48-hour period. In the case of pipe line tanks, the gunite is frequently applied to the roof and about five feet down the side of the shell and the members of the roof-supporting structure. When gunite is applied to the bottom of a tank, it is usually extended up on the shell-and-roof columns a distance of two or three feet. In a few cases the entire shell has been coated.

Typical prices for the application of gunite coatings to tanks in the Gulf Coast area are as follows:

	Cents Per Square Foot
Roof, rafters and girders.....	42
Tank shell and columns.....	46
Bottom	50

These prices include cleaning of the metal by sandblasting and furnishing of all materials. The customer is usually expected to furnish water for mixing gunite and for filling the tanks so that barges may be used as supports for performing work on roofs and tank shells. The customer is also expected to furnish electricity for lights, because this type of work can usually be performed better at night when temperatures inside the tanks are lower and, therefore, more endurable by the workmen. Additional charges are made if the use of buggies is required for application of the gunite to the upper portions of the tanks. The cost of moving to remote locations is extra. The cost of

• CONTINUED ON PAGE 200



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Pressure Surges in Pipe Lines

By E. T. SKINNER

PRESSURE SURGES are water-hammer phenomena caused by valve closing or similar actions, such as unsteady flow from a reciprocating pump. Surge is reduced by the use of surge tanks, surge pistons, and bypass pipes. The use of interference waves is here suggested as a possible solution to the problem of pressure surges. This paper, substantially as reproduced, was presented at the Petroleum Mechanical Engineering Conference of the ASME as a contribution of the Petroleum Division.

PRESSURE surging in pipe lines is a problem confronting pipe line companies today. Surges may create pressures more than double the operating pressure of the pipe line. These pressures surges may, in addition to causing equipment failure by vibration and fatigue, cause destruction of equipment and endanger human lives. A pressure surge is a shock wave produced by the sudden increase or decrease of the velocity of a fluid. The phenomenon is usually referred to as a water hammer.

Pipe line pressure surges may be one of three types classified by cause: (1) pressure surge due to valve closure; (2) pump suction line pressure surge due to interruption of flow into the pump cylinders; and (3) pump discharge line pressure surge due to action of pump pistons.

Surging due to valve closure occurs in the following manner: When a column of fluid in a pipe is suddenly slowed or stopped by a closing valve, the lamina of fluid adjacent to the value is compressed against the valve and pipe. Each successive lamina is compressed in a similar manner until all the fluid in the pipe between the reservoir and the valve is compressed. This creates an abnormal pressure throughout and puts additional strain on the pipe. This cessation of flow and increase of pressure progresses from the valve to the reservoir as a wave action with the speed of sound.

When the pressure wave has reached the reservoir, the entire fluid column will be at rest and at a pressure higher than the fluid in the reservoir. This pressure differential causes a wave of unloading and pressure relief to progress from the reservoir to the valve. This unloading process leaves the fluid in the pipe at a pressure below the pressure of the fluid in the reservoir. The flow again reverses. The cycle is repeated until the fluid friction dissipates the wave energy.

If now the valve were opened and closed at just the proper times, it would be possible to add the pressure of one wave on top of another. By a series of such operations, one could build up any pressure that the equipment could stand.

The magnitude of the pressure surge that may be built up with one closing of the valve is independent of the length of the fluid column. It varies with the density of the fluid, velocity of the fluid, speed of sound in the fluid, and inversely with the acceleration due to gravity. The magnitude also depends on whether there was rapid or slow closure of the valve. A valve is considered to have been closed rapidly if it is closed in less time than it takes for the pressure wave to go from the valve to the reservoir and back to the valve. The maximum pressure is built up by such a closure. Slow closure is considered to have taken place when the time for closure is greater than the time required for the pressure wave to make the round trip between the valve and the reservoir. The slower the closure the smaller the pressure surge. The maximum pressure surge attainable is that for rapid closure.

Pressure surges may develop between the suction manifold and the pump due to the opening and closing of the intake valves of the pump. This type surging is very similar to the pressure surging just discussed. The main difference here lies in the fact that the valve in the line affects surging the entire length of the line, whereas the intake valves affect surging primarily between the pump and the intake manifold. There is some danger here of surges getting in phase and building up very high pressures.

Another source of pressure surges is in the lines between the pump and the discharge manifold. Here the surge is caused by the sudden increase of velocity of the fluid from the pump cyclinder against the fluid in the discharge line. Due to higher operating pressures on the discharge side of the pumps and hence greater surge pressures, this is the type of surge that causes the most grief in pipe line operation. There is also the possibility of surges here getting in phase with one another, developing very high pressures, and destroying pumps and other equipment.

Relieving and Controlling Surges

Surges due to valve closure may be minimized by controlling the rate of valve closure. The rate should be well down in the slow closure region unless some other means of surge relief is provided.

Surges of the other two types must be prevented from getting in phase. This is done by controlling the revolutions per minute of the pump and length of suction and discharge lines. See Appendix 5 for calculations on this topic. Common headers are usually placed as close to the pumps as possible to reduce the possibility of phasing.

All three types of surges can be relieved by the use of open surge tanks. Open surge tanks are open to the atmosphere. They may consist of a standpipe which will maintain a fluid level equal to the pressure head of fluid in the pipe. When a surge develops, the high pressure of the surge merely forces the fluid level higher in the stand pipe. If the surge is of sufficient magnitude, it may force the fluid to overflow. This type of surge control is not suitable for

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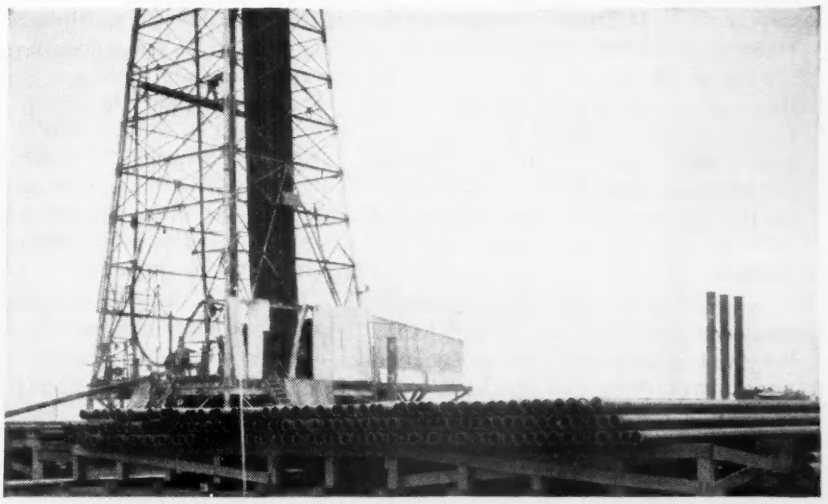

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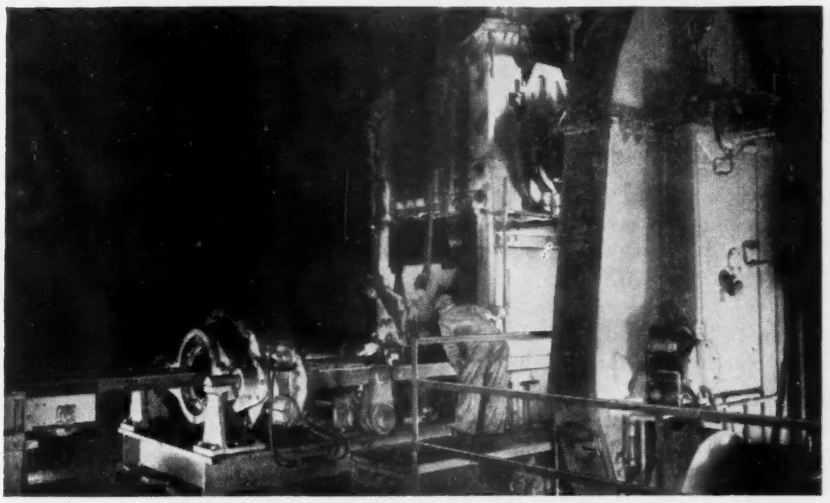

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petroleum due to evaporation and possible overflow losses.

Another device suitable for relieving all three types of surges is the closed or pressure surge tanks. There are several variations of this type surge tank and they will be discussed individually.

In its crudest form the tank is filled with air and closed to the atmosphere. The tank is connected by piping to the oil line. When a surge develops, oil flows into the surge tank, further compressing the air. When the surge passes, the compressed air forces the oil back into the line. It is very effective in relieving surges, but has several disadvantages. The oil has a tendency to dissolve the air and destroy the air cushion. This necessitates draining the tank periodically. One company reports that it finds it necessary to drain the tank every eight hours. There is also danger of an explosive mixture developing and being ignited perhaps by mere compressing.

Variations of Surge Tank

In order to eliminate the fire hazard disadvantage of the air chamber, one variation of the closed surge tank was developed using an inert gas such as nitrogen in place of air. This did not, however, eliminate the disadvantage of gas dissolving in the oil.

Another variation of the pressure surge chamber uses a piston to separate the crude oil from the gas. While this eliminates the two disadvantages of the air chamber surge tank, it has been found that, due to the inertia of the piston, the tank is not very effective in relieving surges.

Still another variation of the pressure surge tank uses a rubber membrane or bag to separate the oil from the gas.

A liquid other than oil has also been used by one company to prevent the oil and air from coming in contact in another variation of the pressure surge tank. The liquid used must be chemically inert to, immiscible with, and heavier than the oil. Air must also be insoluble in the liquid. A water solution of sodium dichromate and a solution of ethylene glycol were two of the liquids used.

It has been reported that the last two variations are not too satisfactory though better than the other methods previously mentioned.

All surge tanks work in a manner similar to a flywheel, i.e. by absorbing energy in a part of the cycle and giving it up later in the cycle.

Another method of combatting surge is the use of bypass pipes. These pipes may be used either on the suction or discharge side of the pumps. The bypass pipe is merely a pipe connecting the discharge or suction lines of two or more pumps. This system combats surge by: (1) permitting averaging the flow variation from the discharge or suction line of one pump to the corresponding line of another; and (2) reducing the intensity of the pressure surge by causing interference between the two split portions of the discharge or suction stream. The author knows of no instance where the bypass pipe location was located to obtain perfect wave interference.

The bypass pipe is usually located as close to the pumps as possible. This method affords greater safety, simplicity of operation, low maintenance cost, and lower first cost than the pressure surge tank method. It is not as efficient as the pressure surge tank method, however.

Surging can largely be eliminated by the use of centrifugal pumps. These pumps deliver the fluid at a more uniform velocity and pressure which greatly reduces surging. However, centrifugal pumps are not suitable for handling low API gravity oil particularly in cold weather.

In order to approach the centrifugal pumps in performance and still handle low API gravity oils, pump manufacturers have developed five and seven cylinder pumps. These pumps do deliver a more uniform pressure and may reduce surge pressure to as low as seven percent of operating pressures. The investment in such pumps is high, however. They require more floor space than centrifugals for installation and maintenance costs may be high.

Other Possible Methods of Control

It is well established that sound waves (essentially pressure surges) can completely interfere with one another so that no sound is heard. If two sound waves of the same frequency and intensity arrive at a point 180 degrees out of phase, no sound will be heard at the point. The same principle can be applied to pressure surges in pipe lines.

This can be accomplished in two ways: (1) by use of a system similar to the bypass pipe; and (2) by use of two pumps connected to the same prime mover.

The common header should be moved far enough from the pump to permit one discharge pipe equal in length to half a wave length to be installed between the pump and the common header. The discharge stream from the pump would be divided into two equal streams. One stream would pass straight to the common header along the path of length equal to one-half the wave length of the surge. The other stream would take a path equal in length to one wave length. Both streams would have the same surge pressure at the common header, but would be 180 degrees out of phase and so eliminate any surge developed by the pump. The disadvantages of the system are that the discharge manifold would be some distance from the pump, (about 370 feet for a duplex double acting pump running at 85 revolutions per minute). Unequal flow pressure drops would also exist due to the different lengths of pipe involved. The system would work for any number of pumps.

It is also possible that two pumps of the same design could be coupled together and connected to the same prime mover. By coupling the two pumps together so that they deliver surges 180 degrees out of phase, interfering surges would eliminate each other in the discharge manifold. The disadvantages of the system would be that one heavier prime mover would be required in place of two smaller ones. When one pump stopped the other would have to stop also. A standby prime mover of large size would be required.

It seems that the solution to the pressure surge problem lies in the use of wave interference rather than in the use of a surge absorbing medium or device.

APPENDIX

1. *Velocity of Pressure Waves*

The velocity of sound, c, in a given material may be computed from the following equation:

$$c = \sqrt{Ev\left(\frac{g}{w}\right)} \qquad (1)$$

where c = velocity in feet per second,
Ev = volume modulus of elasticity of the material in pounds per square foot,
g = acceleration due to gravity, 32.2 feet per second per second, and
w = density of the material in pounds per cubic foot.

If however, the container is elastic as in pipe, the speed of sound or pressure surge will be reduced. In this case the above formula must be modified to:

$$a = \sqrt{Ev\left(\frac{g}{w}\right)} \times \sqrt{\frac{1}{1+\left(\frac{Ev}{E}\right)\left(\frac{d}{t}\right)}} = \sqrt{\left(\frac{g}{w}\right)\left(\frac{Ev \times E \times t}{E \times t \times Ev \times d}\right)} \qquad (2)$$

where a = speed of surge in feet per second,
Ev = volume modulus of elasticity of the fluid in pounds per square foot,

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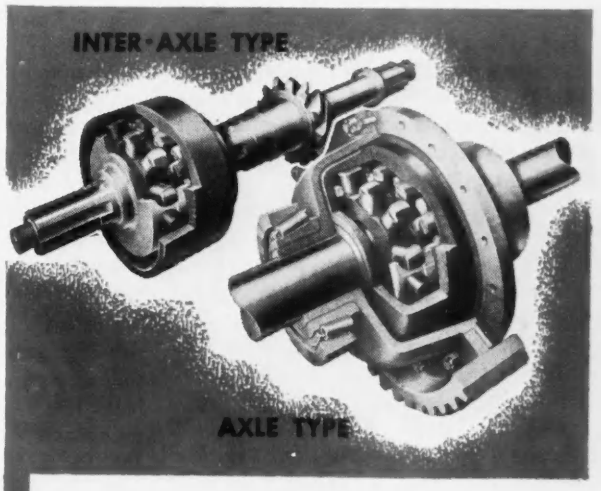

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g = acceleration due to gravity, 32.2 feet per second per second,
w = density of fluid in pounds per cubic foot,
d = internal diameter of the pipe, usually expressed in inches,
E = linear modulus of elasticity of container (pipe) in same units as Ev,
t = wall thickness of container in same units as d.

The velocity of sound in an oil with a specific gravity of 0.80 and a volume modulus of elasticity of 225,000 pounds per square inch, contained in a standard six-inch wrought iron pipe is

$$a = \sqrt{\frac{(225{,}000) \times (144) \times \frac{(32.2)}{(62.4)\ (0.80)}}{}} \cdot \sqrt{\frac{1}{1 + \frac{(27) \times (10^6) \times (0.28)}{(225{,}000) \times (6.065)}}}$$

a = 4210 feet per second.

2. *Time for a Pressure Surge to Travel a Length of Pipe*

The time required for a surge to travel a length of pipe may be computed from the equation

$$T = L/a \qquad (3)$$

where T = time in seconds,
L = length of pipe in feet, and
a = speed of sound in feet per second.

The time for a surge to complete a round trip (for example a valve closure surge) may be calculated from the equation

$$Tr = 2L/a \qquad (4)$$

where Tr = time in seconds for a round trip,
L = length of pipe in feet and
a = speed of sound in feet per second.

3. *Number of Pulsations Produced by a Pump*

The number of pulsations that a pump will produce per second is computed from the equation

$$n = (\text{no. of cylinders}) \times (\text{rmp}/60) \qquad (5)$$

for a single-acting pump and

$$n = (2) \times (\text{no. of cylinders}) \times (\text{rpm}/60) \qquad (6)$$

for a double-acting pump.

For duplex, double acting pump running at 85 revolutions per minute,

$n = (2) \times (2) \times (85)/(60) = 5.66$ pulsations/second

4. *Wave Length of a Pressure Surge*

The wave length of the pulsations of a pump may be calculated from the equation

$$\lambda = a/n$$

where λ = length of a wave in feet
a = speed of a surge in feet per second
n = number of vibrations per second produced by the pump.

For duplex, double-acting pump running at 85 revolutions per minute pumping oil into a six inch standard wrought iron pipe,

$\lambda = 4210/5.66 = 744$ feet

5. *Phasing of Pump Surges*

Phasing of the surges from the pump will develop when the length of pipe from the pump to the manifold is equal to the wave length of the surge or to some fraction, i.e. ½, ¼, ⅛, et cetera, of the wave length. When phasing develops, surge pressures become additive and extremely high pressures result.

For a duplex, double-acting pump running at 85 revolutions per minute, the wave length was found to be 744 feet. If now the distance between the pump and the manifold is 744 feet, 372, 186, 93, 46.5, et cetera, phasing will result. Care must be exercised in design of pump installations to prevent selection of a discharge line length that could produce phasing.

Phasing of pump surges may also occur between two pumps should they deliver surges at the same time. Internal combustion prime movers will usually vary in speed enough that there is little or no danger of phasing. However, when electric motors, which have rather constant speeds, are used as prime movers, care should be taken to prevent the pumps from getting in phase with one another. This can best be done by setting one motor to operate at a little higher speed than the other.

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ACKNOWLEDGMENTS

The author wishes to thank the Interstate Oil Pipe Line Company, Tulsa; Tulsa Pipe Line Division, Gulf Refining Company, Tulsa; Ajax Pipe Line Corporation, Springfield, Mo.; and Mid-Continent Pipe Line Company, Tulsa, for information used in the preparation of this paper.

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Internal Corrosion of Crude-Oil Tanks

■ CONTINUED FROM PAGE 194

this coating is relatively high, but it appears to be quite effective in preventing corrosion for long periods of time, even when the corrosive conditions are unusually severe. Until the effectiveness of less expensive coatings is improved, it appears that this coating is the most satisfactory and economical one available.

In some cases special methods of tank construction have been used to reduce the rate of corrosion attack. Perhaps the simplest of these is the installation of a bottom which is sloped toward a sump so that salt water may be collected and drawn off, thus removing the principal corrosive agent. In the case of bolted tanks, a roof is sometimes installed in an inverted position as a tank bottom. One of these tanks was recently inspected in West Texas after one year's service, and it was found to be in perfect condition. This particular tank bottom had a pitch of one inch to one foot, and had been installed without protective coating other than the aluminum paint applied by the manufacturer. If this type of construction were applied to larger tanks, the pitch would need to be reduced and a protective coating would be needed because the salt water would not drain to the sump so readily.

Floating roofs are widely used for the double purpose of reducing corrosion and reducing evaporation losses. This type of roof practically eliminates the vapor spaces, and thus greatly reduces the corrosion. It is understood that other types of roofs involving methods for elimination of the vapor spaces are under development.

Another method of corrosion control which is under development, but upon which at present little information is available, is the use of neutralizers and inhibitors. It is possible that corrosion inhibitors could be added to the water carried in the bottom of tanks. It is also likely that corrosion inhibitors or materials which would neutralize the corrosive agents could be added to the petroleum vapors to reduce or prevent corrosion in the vapor spaces. It is known that some producing companies are experimenting with the use of oil-soluble inhibitors for the prevention of corrosion of oil-well casing and tubing. These inhibitors can be expected to remain in the oil, and they have a beneficial effect upon the pipe line carrier's facilities with which they come in contact. The present cost of these inhibitors is too great for pipe line use; but it may be that, if they were widely adopted by producers, a beneficial effect would be noted by the pipe line carriers.

PIPE LINE *Construction*

By CECIL SMITH
Staff Writer

FINAL action has been taken by FPC authorizing Texas Gas Transmission Corporation to build and operate a 26-inch natural gas line from fields of Texas and Louisiana to a connection with the Big Inch system in Ohio 800 miles away.

Much of the preliminary work necessary to construct the line has been accomplished in advance of FPC's approval. Pipe and other materials have been purchased and stored along the right-of-way. Surveys have been completed and a large part of the total right-of-way has been obtained. Contracts for the entire job have been awarded to seven contractors and actual construction is about to start.

Communities from Mississippi to upper New York state will receive natural gas supplies as a result of this project. Some will be supplied as early as this coming winter and by the spring of 1950 the entire line will be in full operation. Ultimate capacity will be 400 million cubic feet of gas per day and by this year's heating season deliveries are expected to reach 304 million.

Texas Gas Transmission Corporation was formed through the merger of Memphis Natural Gas Company and Kentucky Natural Gas Corporation in 1948. Memphis Natural owned and operated a transmission system originating in Louisiana and extending through Arkansas and Mississippi into Tennessee. A transmission system in Indiana, Illinois, Kentucky, and Tennessee was owned and operated by Kentucky Natural. These systems, totaling 1600 miles, will be operated in conjunction with the line now to be built and operated by Texas Gas.

The line will extend from the East Carthage gas field in Panola County, East Texas, through the Mississippi and Ohio River valleys, to a point near Middletown, Ohio, where it will connect with the Big Inch pipe line facilities of Texas Eastern Transmission Corporation. Cost of the line and its ten compressor stations totaling 68,800 horsepower is estimated to be $73½ million.

Pipe Line Construction

Table includes projects planned, contracts awarded, and spreads or entire projects completed since the last issue of WORLD OIL

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size (Inches)	Daily Capacity (Barrels Cu. Ft.)	REMARKS
CRUDE OIL LINES					
Pan American Pipe Line Company	Extension to gathering system, Pettus field, Bee County, Southwest Texas	5	4	1,000	Completed in March by E. M. "Elex" Null, Houston, Tex.
Standard Oil Co. of California	Wilmington to Torrance, California	10	10	15-20,000	Construction started in March by Pacific Pipe Line and Engineers, Ltd., Los Angeles. Will complete in May.
The Texas Pipe Line Company	Blessing Junction, Matagorda County to Markham Station, Upper Texas Coast	13½	6	.....	Sheppard-Geiger Construction Co., Corpus Christi, has contract.
	Pickett Ridge, Kubela and Lakeview fields, Wharton County to Withers Station, Upper Texas Coast	15	10	.....	Contract awarded to Associated Contractors and Engineers, Inc., Houston.
	Chocolate Bayou field to Manvel Station, Brazoria County, Upper Texas Coast	16¼	6	.....	Latex Construction Co., Houston, has contract which also includes 2 6/10 miles of field gathering system.
NATURAL GAS LINES					
Cities Service Gas Company	Between Hutchinson and Ottawa, Kansas	130	26	.....	This section of the 405-mile Hugoton to Kansas City line was started in March by R. H. Fulton & Co., Lubbock, Texas.
City of Indianapolis	Texas Eastern's "Inch" line to City's plant, Indiana	55	16	50 mln.	Amended application made to Federal Power Commission. Project would cost $2.4 million.
Gulf Oil Corporation	Odessa, Ector County, to Waddell Gasoline Plant, Crane County, West Texas. Gathering system.	50	3 to 30	.....	J. J. Willis Construction Co., Odessa, started in April and is scheduled to complete June 15.
Home Gas Company	Proposed line in Orange, Sullivan and Rockland Counties, New York	70	.....	.....	FPC authority has been requested. Estimated cost is $2,447,994.
Hope Natural Gas Company	Loop from Shirley, Tyler County, to Hastings, Wetzel County, West Virginia	12 3/10	14	.....	Pipe Line Construction and Drilling Co., Camp Hill, Pennsylvania, is scheduled to complete this $500,000 project about July 1.
	Loop from Hastings, Wetzel County, to Clarksburg, Harrison County, West Virginia	33	16	.....	Same firm has contract and will begin construction when the first loop is completed. Cost will be $1,089,000 and is scheduled to finish November 1.
Imperial Oil Company, Ltd.	Gathering system and flow lines in Leduc field, Devon, Alberta, Canada	47 50	4, 6, 8 3 & 4	....	Sparling-Davis Co., Ltd., Edmonton, Alberta, started work in April and will complete as pipe is available.
Michigan-Wisconsin Pipe Line Co.	Big Rapids, Michigan, to near Valparaiso, Indiana	180	22	.....	Section of Texas Panhandle to Michigan line. Oklahoma Contracting Co., Inc., Dallas, began in March and will complete about September 1.
Mississippi River Fuel Corporation	Monroe Gas field, Louisiana, to Fredericktown, Missouri	215	24	.....	Contract for this looping was awarded R. B. Potashnick, Cape Girardeau, Mo., and will start June 1.
Northern Natural Gas Company	Proposed looping of Texas Panhandle to Minnesota line in Kansas, Nebraska and Iowa	327	.....	60 mln.	Application to FPC also includes 10 compressor units of 16,000 hp. and dehydration plant at Garden City, Kans. Project will boost line capacity to 530 mln. and will cost $27.8 million.

Pipe Line Construction—Continued

Table includes projects planned, contracts awarded, and spreads or entire projects completed since the last issue of WORLD OIL

COMPANY	Origin and Terminus	Length (Miles)	Pipe Size (Inches)	Daily Capacity (Barrels Cu. Ft.)	REMARKS
Northern Natural Gas Company (Continued)	Third line north of Clifton, Kans., Station	9 1/10	24	.....	Eastern Construction Co., Dallas, started at Clifton on April 1. Laying of 20-inch will follow completion of 24-inch. One spread working.
	Loop northeast of Palmyra, Nebraska, Station	29½	24	.....	
	Loop north of Oakland, Iowa, Station	18	24	.....	
	Loop north of Palmyra, Nebraska, Station	21¼	20	.....	
	Loop north Ogden, Iowa, Station	22	24	.....	Contracts for these three projects awarded to G. G. Griffis Construction Co., Tulsa. Will start at Ogden about May 1, weather permitting.
	Loop north of Albert Lea, Minnesota, Station	26	24	.....	
	Farmington, Minn., to Portland Ave. Station, Minneapolis	11¾	24	.....	
	Boone River crossing, near Eagle Grove, Iowa	.....	20 & 24	.....	Awarded to C. S. Foreman Co., Kansas City.
	Gathering system at Hugoton field, Garden City, Kans	36	16 & 24	.....	Bids will be requested soon.
Northern Oklahoma Gas Company	Three Sands field to Ponca City, Oklahoma	13	16	50 mln.	Construction will be started by Goldenstern Pipe & Supply Co. as soon as ground conditions permit.
The Ohio Fuel Gas Company	Proposed replacement line in Central Ohio	85½	.....	.....	Application made to FPC to replace 84 miles of old line that will be retired. Estimated cost is $4,167,000.
Piedmont Natural Gas Corp	Proposed line from Louisiana and Texas coast fields to Richmond and Norfolk, Virginia	1290	20	275 mln.	Original FPC application for 990 miles amended. Project would include nine stations of 48,000 hp. and would cost $97,380,000.
Public Service Co. of Northern Illinois	Park Forest, Illinois, vicinity	6½	¾ to 8	.....	Midwestern Contractors, Inc., Chicago, will complete May 1.
Standard Oil Co. of California	Montebello field to existing line serving El Segundo, Calif., Refinery	6	6	.....	Line will carry fuel for refinery and will replace old line. Alex Robertson Co., Bakersfield, will complete in May.
Stanolind Oil & Gas Company	Gathering system in Hugoton field near Ulysses, Kans.	137	4 to 22	.....	Deaton & Sons, Inc., Odessa, started in April and wil complete in June. Cimarron River crossing included.
Tennessee Gas Transmission Co.	Loop between Refugio and Victoria, Texas Gulf Coast	62	24 & 30	.....	H. C. Price Co., Bartlesville, and Bechtel Corp., Tulsa, will start construction May 1.
Texas Eastern Transmission Corp.	Loop between Lebanon and Summerfield, Ohio	177½	26	.....	FPC certificate granted. Five new stations and changes to four will give additional 38,000 hp. and will up system to 740 mln. feet. Brown & Root, Inc., Houston, has contract for the 26-inch loop and will start May 1. Lines and stations will cost $24,052,000.
	Provident City field to Baytown "Inch" terminal, Texas Gulf Coast	100	16	.....	
	Loop near Beaumont, Texas Gulf Coast	33½	20	.....	
	Loop between Castor and Lisbon field, Louisiana	36	20	.....	
Texas Gas Transmission Corp.	Lisbon field, Louisiana, to Middletown, Ohio	723	26	400 mln.	Authority granted by FPC. Project includes ten stations of 68,800 hp. and total cost will be $73½ million. Work will start immediately and is scheduled for completion in Spring, 1950. Texas Eastern's Big Inch System will connect with this line at the Ohio terminus.
	Carthage field, East Texas, to Lisbon field, Louisiana	110	20	.....	
	Lateral line from Madisonville, Kentucky, to Evansville, Ind.	32	12	.....	

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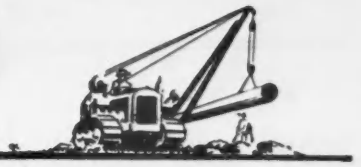
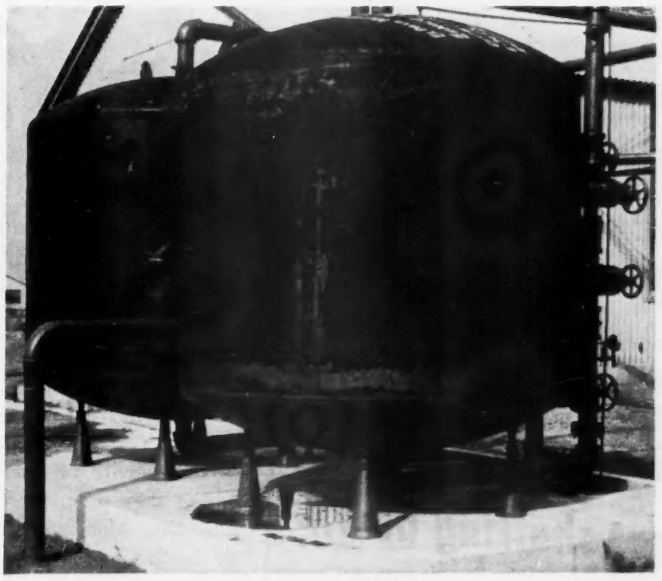


$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

HOW TO—Support and Level Large Water-Treating Vats



In many areas there is considerable mineral content in the natural waters obtained from wells. This "hard" water is extremely undesirable for many uses, and particularly so for the cooling system in a large gas compresser station.

Large volumes of gas are handled each day, and the compressors must be kept cool during the compression process. One large cooling system handles the job of furnishing cooling water to all compressors at the station. Since the water used in the cooling system is subject to heat, the minerals in the water will form a deposit on the heat exchange equipment and in the cylinder heads of the compressors unless the minerals are removed.

It was necessary for one gas company operating in West Texas to treat the cooling water used at the compressor station. In setting up the water treating system, two large steel vats shown were employed. The treating and filtering material in one could be cleaned and reactivated while the second vat furnished treatment of the water used in the system. In this manner, there was a continuous treatment provided the cooling water.

To simplify the foundation setting of these heavy vats, the designers employed several heavy-duty, screw-type jacks as shown. A simple concrete slab was poured to accommodate the weight and piping to and from the tanks. This simplified setting saved in concrete construction for a foundation as well as made the tanks completely accessible at all times for painting and inspection. Small metal sockets were welded to the tanks where the heads of the jacks rested. Four of these jacks per tank sufficed and their construction made it possible to level the vats easily once they were set in place.

HOW TO—Store Pipe Line Maps for Convenient Reference

The problem of adequate storage for pipe line maps is of importance to station engineers and maintenance crews. It is necessary that the maps showing flow lines, trunk lines and connection points be preserved and at the same time be readily available when needed without having to literally "tear up" the records office for the one required.

An efficient map holder for ready reference is quickly and economically constructed to meet the needs of most pipe line stations. It is made from the standard 40-inch household window shade. Each shade will hold two regulation size maps which are mounted in place with Scotch tape. The shades are so mounted that each extends an additional three-fourths inch out from the wall over the shade below it, thereby providing smoother operation. This stair-step

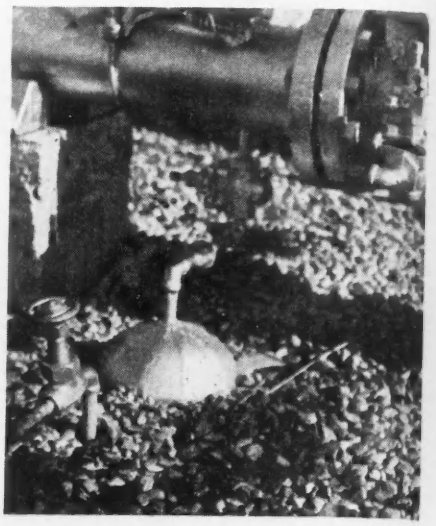
type mounting is accomplished with a ¾ x 2-inch wooden block of 12 inches, 9 inches, 6 inches and 3 inches in length, respectively. The 12-inch base holds the lower shade while the three-inch block supports the top shade. The nine-inch and six-inch blocks mount the second and third shades in pyramid fashion.

The unit is mounted on the wall by means of two light-weight pieces of strap iron screwed to the tops of the ¾ x 2-inch material, and fastened to the wall moulding. For quick identification, regular file tabs containing map numbers and other pertinent information are attached to the bottom corners of each shade. In this manner, the maps are kept neatly filed, out of the way, and always ready for use. They are not subjected continually to dust and light which tend to mar the appearance of maps, especially blue prints.

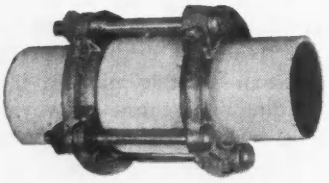
HOW TO—Drain Flowing Condensate from Pipe Line Meter Run

Condensate flowing with the gas into a meter run is partially blocked in its travel by the orifice plate and frequently causes incorrect recording of the volume handled by the pipe line. When the line is equipped with adequate drips, the quantity of condensate is obviously small, but enough can eventually build up to create the difficulty.

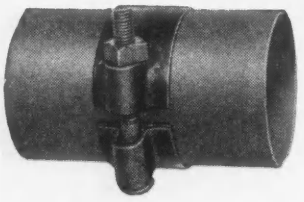
To remove constantly the condensate from the upstream side of the orifice fitting, the meter run can be perforated on the lower side with a three-eighths inch pipe tap for connecting a disposal line, through a positive shutoff valve, to a small receiver, or drip, placed nearby.



The drip may be made from a short section of eight-inch pipe closed at each end with an orange peel weld, having a pipe nipple inserted at each end, one for the inlet from the meter run, and the other for the blow-down. As the controls for the drip are in the immediate vicinity of the orifice fitting and the recording meter, the line walker can conveniently drain condensate each day as the charts are changed.



COLLAR CLAMP
Styles 4 and 41, for repairing and preventing leaks through threads of screw collars.



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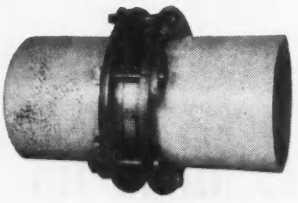
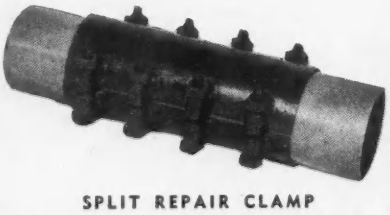


POROUS-WELD CLAMP
Style 55, for repairing circumferential weld leaks.



SPLIT REPAIR CLAMP
Style 79B, for repairing pitholes and longitudinal splits in pipe.

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HOW TO—Maintain Oil Level

The oil level in the crank case of an internal combustion engine operating continuously has a tendency to become lowered due to the dissipation of the lubricant past the piston rings. Each engine has its own characteristics, and one might be operated for a considerable length of time before new oil is required to raise the level, while another might require frequent additions to obtain the same results. To guard against a dangerously low oil level in individual well pumping engines, a self-replenishing device is used which operates on the same principle of that of a poultry watering apparatus; consisting of a glass jar set in a shallow pan so that, when the water is consumed, the level in the pan is replenished when the vacuum in the jar is broken.

The oil level device is a box-like reservoir, having a capacity of approxi-

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AR...	ARUBA.....	.....14:55.....	.....07:10.....
AR...	CURACAO....	.....16:20.....	.....08:35.....
AR...	MARACAIBO..	.....16:40.....	.....08:45.....
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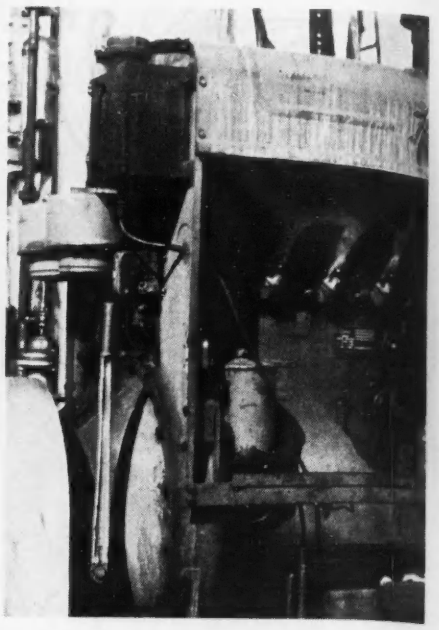


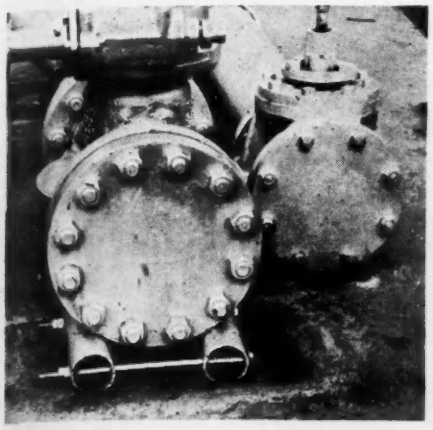
mately one gallon, made of light weight steel with air and oil tight welds at the seams and containing brackets on one side for attachment to a portion of the engine enclosure. A filler connection is attached to the top by welding a short two-inch pipe nipple with threads at the top to receive a common malleable or cast iron cap, to provide an air tight fit.

Conventional fittings are connected to the bottom of the reservoir to attach a copper lead line to the oil level indicating apparatus on the side of the crank case. An extension at this point supports an ell and a pipe nipple into which the copper tubing is inserted so the open end will be slightly below the top level of the oil. As the oil level falls until the copper tubing is uncovered, air will automatically bleed back and up into the reservoir so oil will flow freely downward into the crank case.

HOW TO—

Adjust Pipe Height

Instead of using leveling wedges of metal, or perhaps cribbing with wood, pipe line headers which are laid approximately on the ground surface can be straightened with an easily constructed contraction leveler, made of pipe and two machine bolts. Two pieces of two-inch pipe of equal length are prepared by drilling through both walls



at each end, using the required size drill for the available machine bolt. The length of the two pieces of pipe is governed by the width of the gate, or fitting flange and by the size of the concrete pad, or floor, where the pipe had originally been placed.

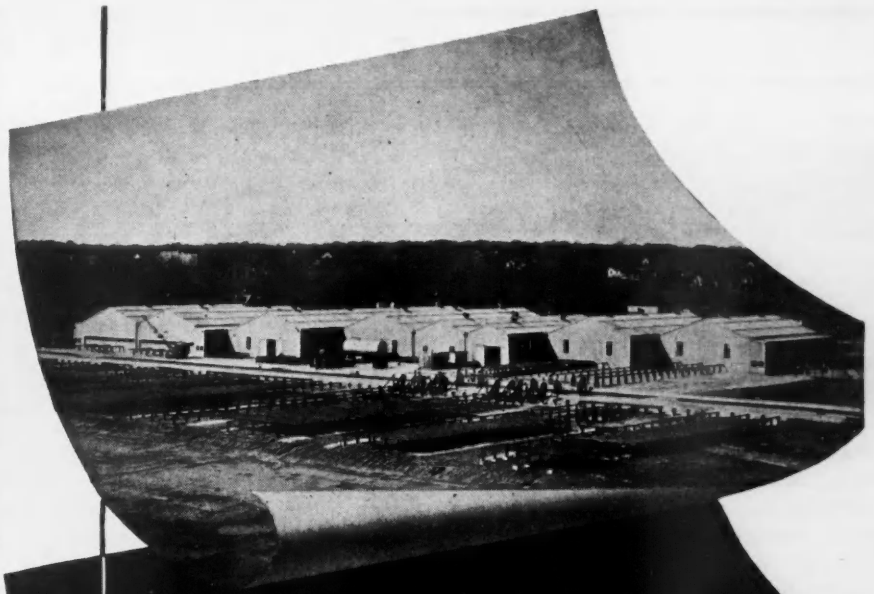
If the pipe line is lower at one end than desired, and the point where it is to be leveled is beneath an eight-inch companion flange, the length of the two pieces of pipe can be about six inches. Select the two machine bolts which are long enough to pass through matching holes in both pieces of pipe when laid side by side, but separated about eight inches. Lay the pipe on opposite sides of the flange before inserting the machine bolts. When the leveling device is pulled up snugly against each side of the flange, the amount of lift available is approximately two inches when the nuts are run down equally on each machine bolt. When the amount of lift is obtained, lock nuts on the bolts will prevent misalignment because of loose bolts.

HOW TO—

Separate Pipe Lines

When a smaller pipe line is laid above one several inches larger than the first, and both cross ravines or narrow gulches, separation of the two is not an involved process. If either or both lines are insulated, or wrapped with an impervious coating, holidays can be prevented by the method accompanying the installation of the separator.

The separator is simply a four-inch nipple of four-inch pipe with saddles on either end, each cut and shaped to fit the respective line, whether the eight, for example, or the ten-inch, is the lower of the two. To prevent exchange of



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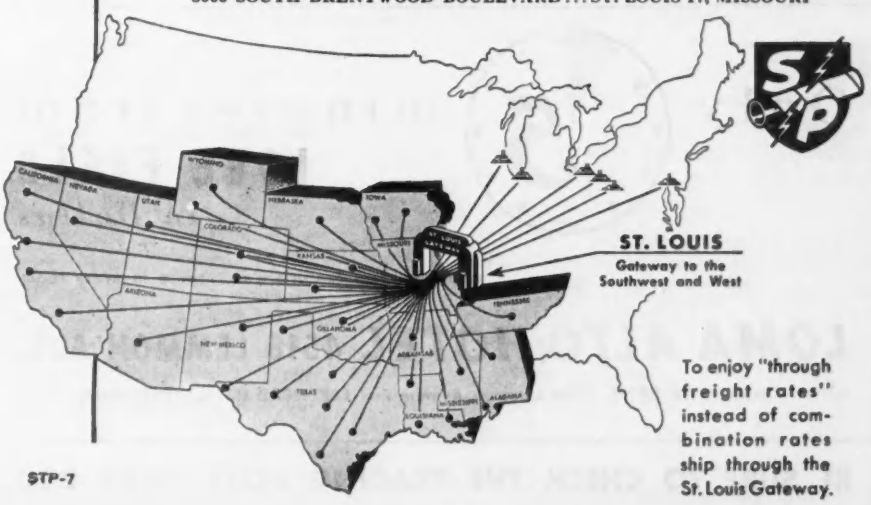

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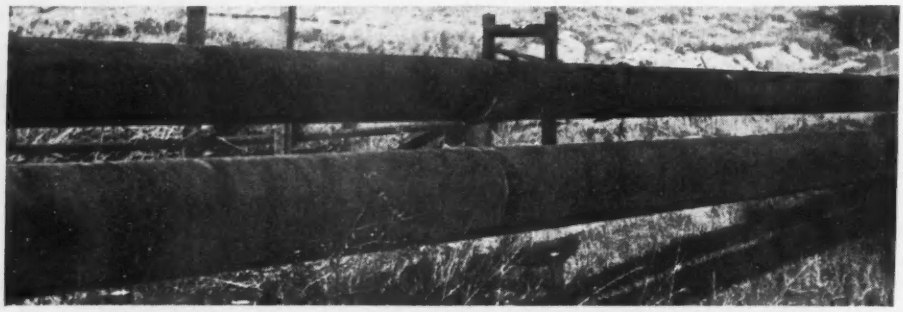

stray currents encountered in some areas, both saddles are prevented from touching the metal walls of the lines with adequate separators. A liberal application of coating, which may be a high-melting asphalt is applied to cover an area larger than the saddle. It is followed with a pipe covering padding which will not shear or compress. Adequate separation of the two lines is obtained with this separator, and either or both lines can be protected with cathodic current without bleeding to interrupt the flow of the current from the ground to the line, or bled away with an efficient installation of grounds.

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A small ordinary hasp was welded to the lower half of the flap door. The loop for the hasp tongue slot was welded to the bottom side of the cylindrical torch container. A semi-circular notch was cut out of the edge of the flap door on one side of the hasp to accommodate the gas hoses. The entire torch receptacle assembly was then welded to the frame made of pipe used for holding the gas bottles in an upright position, just behind the cab on the transporting truck.

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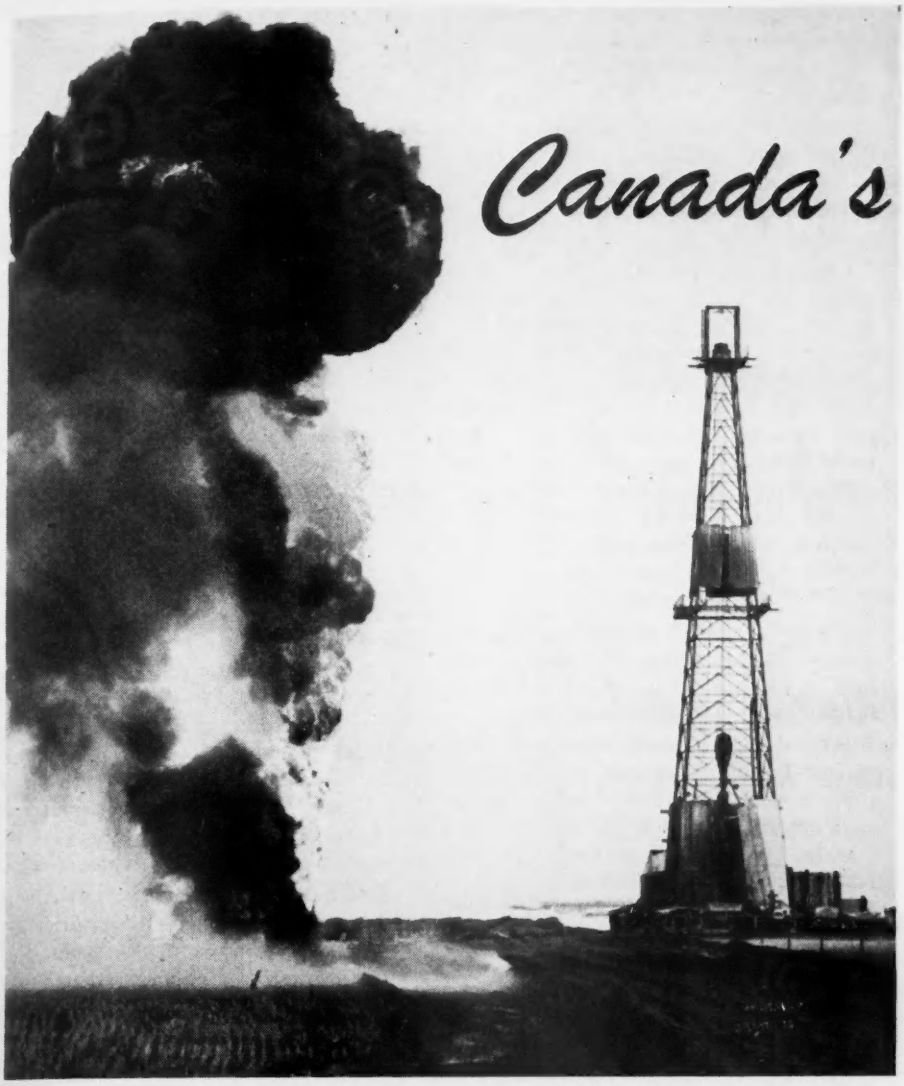

Canada's Problems:

Transportation and Refining

By C. O. NICKLE

Staff Correspondent

Imperial Oil, Ltd's. Schoepp 1, discovery well at Golden Spike in Central Alberta, cored and tested 544 feet of highly productive Devonian coral reef limestone, by far the thickest single section of oil pay yet found in Canada. The well entered the reef and showed first oil on drill-stem test February 9. Pay was topped at 5363 feet. The well, after coring and testing 5 to 20 feet daily for two months, was below 6000 feet early in April, and was expected to complete for production by end of April. The picture above shows the Golden Spike discovery flowing into the burning pits during one of the more than 40 drill-stem tests run in the Devonian pay.

WITH PRODUCTION surging upward and exploration intense, Western Canada faces a period of growing pains during which refining and transportation facilities must catch up. When these problems are solved, the nation will be near its goal of self-sufficiency in petroleum.

OIL discoveries and development of potential are running ahead of expectations in Alberta, and have outraced pipe line and refinery projects planned for 1949-50. With development drilling in fields discovered the past 27 months and exploratory drilling all over Alberta continuing at the highest rate in Canadian oil history, Western Canada's oil industry faces for the next year or more a period of growing pains.

Beyond this period, Alberta's oil producers and explorers . . . Canadian and American . . . see an increasingly bright prospect of Western Canadian oil reaching full maturity, with a vital role in the oil economy of North America, as well as in the Prairie provinces which are its first natural, and now nearly self-sufficient, market.

That full maturity requires continued large scale exploration for new reserves, and development of more potential, and there is not expected to be any material reduction in scale of operations during the period immediately ahead.

The modern story of Alberta oil starts with Imperial Oil, Ltd's discovery of Leduc in February, 1947. At that time the province was producing around 19,000 barrels of oil daily, mainly from the aging Turner Valley field, Canada's first major pool. Production climbed to 25,000 barrels daily by the end of 1947; to 40,000 barrels daily by the end of 1948; and further increased to a high of 58,000 barrels daily in mid-March, 1949, before loading of Prairie province refinery storage brought a measure of "market proration." By mid-April, actual potential was rated around 65,000 to 70,000 barrels daily, and is expected to increase to around 100,000 barrels daily by year's end.

Starting with the Leduc discovery, a minimum of 600 million barrels have been added to Alberta oil reserves. The total new reserves could be boosted to

1 billion barrels or more by the year's end, through the fuller development of 1948-49 discoveries so far made, without allowing for further discoveries.

Leduc-Woodbend now has an oil reserve rated at 250 million barrels, the bulk of it in the Devonian coral reef (D3 zone) which forms the core of the structure at depths from 5200 to 5400 feet. Around 5000 feet down is the D2 Devonian dolomite which is an important part of the oil reserve, while around 4100 feet are Lower Cretaceous sands producing oil and gas at a number of wells. Current productive area covers around 15,000 acres. By early April, Leduc-Woodbend had 215 producing wells, running about 30,000 barrels daily. Quotas are 150 barrels daily for D3 wells and 100 barrels for D2 and Cretaceous wells.

Redwater, discovered by Imperial in September, 1948, now rates as a much greater reserve than Leduc. Production has so far been established along a ten-mile line, three miles wide in its developed mid-section, with minimum reserve placed at more than 300 million barrels. Some estimates of possible reserves range up to double that minimum figure. Redwater is about 50 miles northeast of Leduc. The oil source is Devonian coral reef limestone, found from 3150 to 3300 feet. Maximum thickness of oil pay so far found is 150 feet. Leduc's D3 zone has a 35 to 40 foot oil column, overlain by a gas cap ranging up to 170 feet in thickness, and underlain by an effective water drive. Redwater has no gas cap, and no evidence as yet of an effective water drive. Twenty Redwater wells, completed by early April, show a range in potentials from 1000 to 2500 barrels daily. During the early spring some Redwater wells were operated at rates ranging from 600 to more than 1000 barrels daily. They are now cut back, because of market proration, to between 300 and 500 barrels daily.

Golden Spike Discovery

On February 9, 1949, Alberta's third prospective major Devonian reef field was discovered, again by Imperial Oil, this time at Golden Spike about five miles west of the north end of the Leduc-Woodbend fields. Coring and drill-stem testing from five to 20 feet daily, with oil flows reaching the surface in as little as seven minutes or as much as one hour, the Golden Spike discovery found 544 feet of oil-bearing pay by early April, and then entered tight limestone yielding only shows of oil and gas, but with no evidence of water down to the 6000 foot level. The oil pay started at 5363 feet. The well was expected to go on production late in April, with every reason to believe that the potential, like the thickness of oil pay, would be the best yet found in Canada.

Imperial has started two stepouts, one three miles northeast, the other 3½ miles northwest of the Golden Spike Discovery. These should get their answer early in May.

Other oil discoveries made in 1949, of still undetermined importance, include: Joseph Lake, a Viking sand (basal Upper Cretaceous) discovery of 38 gravity oil at 3265 feet 20 miles east of Leduc field. The Joseph Lake well, drilled by four Canadian independents on an Imperial 8960-acre lease farmout, showed a flush flow through one-half inch choke of 528 barrels daily, is now on test through 10/64 inch choke at 70 to 80 barrels daily. Followup development is planned by the owners.

Barrhead is a Madison limestone discovery of 24-gravity oil around 4900 feet about 50 miles northwest of Leduc field. The discovery was made by Stanolind Oil & Gas Company, drilling on an Imperial farmout block. While capable of making considerable oil, the well has a fairly high gas-oil ratio and a water cut up to 20 percent. The well continues to test and, if results warrant, further development will be undertaken.

Bon Accord is a D2 Devonian limestone zone discovery of light crude around 3300 feet between Leduc and Redwater. The discovery was made by Imperial Oil, and testing is currently under way.

Drilling operations have been expanded in Alberta to about 95 rigs, with the number expected to increase this summer to as many as 125 rigs. At the time of the Leduc discovery, Alberta had 20 rigs running. This increased to 50 by the end of 1947, and to 80 by the end of 1948. Nearly one-half the rigs are engaged on exploratory drilling, either on geophysical pictures or stratigraphic tests.

By early April the 1949 rush for exploration reservations in Alberta had boosted the total lands under exploration in the province to more than 50 million acres, pretty well solidly blocking the Plains area of Alberta for 600 miles north from the American border.

At present about 65 geophysical parties are working in Alberta, compared with only 15 in 1946 and 22 in 1947. The number is expected to increase this summer.

The exploration play has also extended into other Western provinces, into northeast British Columbia, the plains of south and central Saskatchewan, and the southwest corner of Manitoba. While these operations are currently small, compared with the Alberta play, there is a good prospect of activities considerably increasing.

Western Canadian oil has now reached the point in production and reserves where markets must be found beyond the Prairie provinces. Prairie demand was around 58,000 barrels daily in 1948, and is expected to run around 65,000 barrels daily in 1949, with growth expected to continue in subsequent years.

One current problem is refining capacity. Prairie capacity in 1948 was 46,000 barrels daily. This is being increased this year to 54,000 barrels, in 1950 to about 61,000 barrels, and in 1951 to around 70,000 barrels, to meet the growing Prairie demands.

Prices Adjusted

Late in 1948 Alberta crude prices were adjusted downward to permit competition by rail haul with American and other foreign crudes on the outer fringes of the Prairie market, which extends from the Kootenay region of British Columbia eastward to Winipeg, Manitoba. Barring downward revision of American oil prices, no important revision in Alberta crude prices are anticipated for the next few months.

The first major step to permit Alberta crude to move beyond the prairies is a 450-mile pipe line from the Leduc-Redwater region to Regina, Saskatchewan. This line, to be built by Imperial, now has steel supply arranged for, and will be laid in the spring and summer of 1950. It will reduce oil transport costs as far as Regina to about one-third of the rail rate, and will make it economically possible for Alberta crude to move southeastward into the U. S., and eastward beyond the Great Lakes in Canada.

During the interim period, pending completion of the Regina line, Imperial Oil officials believe that negotiations now under way will result in special rail freight rates being set to enable some Alberta crude to move by rail to the Pacific Coast and to the Great Lakes. Such interim arrangements, of course, will not take care of Alberta's fast growing oil potential, although they should permit production to expand during the next year to some extent beyond prairie needs.

During the past two years Alberta crude has been able to flood out into the Prairie area. During the next year or so of "growing pains" it will probably seep out past the economic barriers on the fringes of the priaries. Major pipe lines east and west and south are likely in the future to permit Alberta oil to flood out into far broader markets, and bring the day of Canada-wide self-sufficiency (in balance) in petroleum closer to reality.

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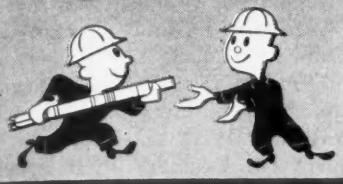

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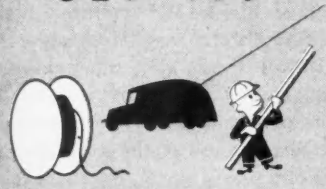

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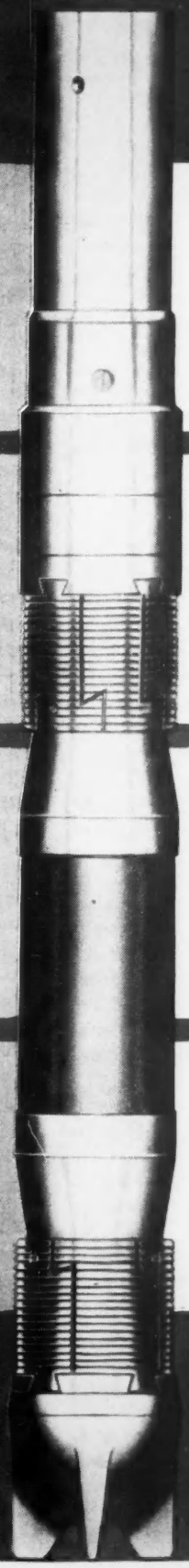

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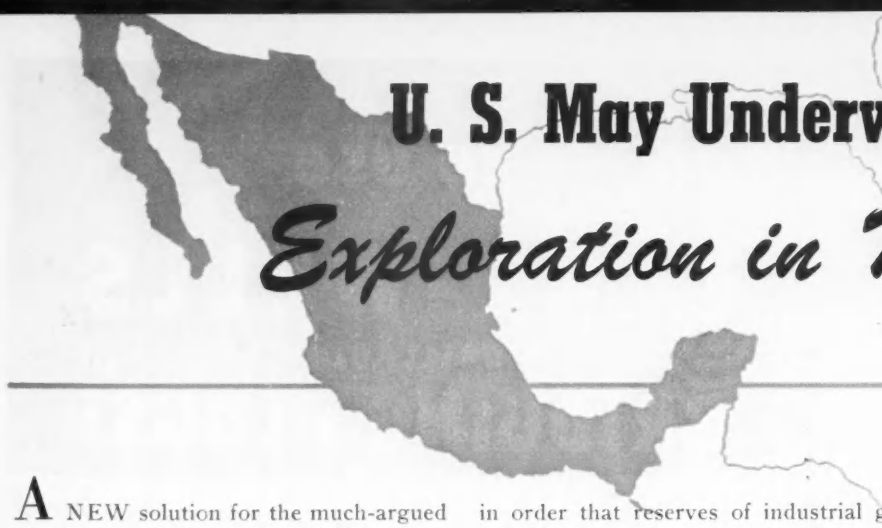

U. S. May Underwrite *Exploration in Mexico*

A NEW solution for the much-argued Mexican petroleum loan has been proposed in Washington, embodying these principles:

1. The Export-Import Bank would approve a grant not directly to Mexico, but as a fund to underwrite American operators who effect contracts with Pemex, Mexico's state oil monopoly. This deal might make as much as $100 million available for oil development work in Mexico.

2. No part of this loan could be used on projects for which private capital is available. That means the bank grant would go to the strengthening of Mexico's own internal oil economy, such as the construction of the Monterrey refinery, and perhaps another at Salina Cruz, and completion of the Salamanca plant; and the laying of pipe lines, both for crude and products.

3. To bring the plan within the legal possibilities of the Export-Import Bank, the U.S. funds so approved would be used to discount Mexican bonds offered American operators working in Mexico, provided that all contracts signed with Pemex were with lowest American bidders on any given project.

After Pemex Chief Antonio J. Bermudez had spent several weeks in Washington, it became clear that Mexico and the U.S. were still far apart on their thinking. Mexico does not intend to change her basic oil law under which sub-soil rights belong to the nation and by which Pemex retains full operating management. That position virtually blocked any kind of straight U. S. loan, as originally sought. The new formula grew out of the mutual conviction that some U.S. aid must be given Mexico for development of her oil industry. The State Department publicly announced that it was studying Bermudez' proposal for a loan, and said: "The general plan for the development of the Mexican petroleum industry includes construction of a pipe line across the Isthmus of Tehuantepec, a plant for the production of lubricating oils, the construction of new refineries, the modernization of refineries now in operation, and the construction of additional transportation facilities in Northeast Mexico in order that reserves of industrial gas may be utilized as fuel for industrial developments in Monterrey, Torreon and other cities of that area. The appropriate U.S. authorities are studying this proposal in the expectation of further conversations with Senator Bermudez."

Meanwhile, Ralph K. Davies, president of American Independent Oil Company, announced the formation in Mexico of American Independent Oil Company de Mexico, S.A., and said:

"This new Mexican company will assume American Independent's responsibilities for exploratory geological and geophysical work and development drilling under contracts entered into in conformity with Mexican law by Senator Antonio J. Bermudez, director general of Pemex, and a group of American independent operators, including American Independent."

First Site

The initial area to be developed lies on the Gulf Coast side of the Isthmus of Tehuantepec in Southeastern Mexico. It includes both submerged lands and uplands. Davies said "This area is highly promising from a petroleum standpoint and the contracts provide the basis for a mutually profitable operation from which the Mexican government and the contracting group should realize substantial benefits. Work already has commenced."

The arrangement with Mexican American Independent (known as CIMA) is the first free entrance of North American oil operators into Mexican exploration and development since the expropriation in 1938, said Davies.

The agreement with Pemex provides that CIMA will be reimbursed for all costs and expenses approved by Pemex out of proceeds of 50 percent of the oil and gas produced from new wells drilled. In addition, the American operators will receive during the 25-year life of the contract as compensation for work performed, risks run and technical assistance, the value of percentages of gross production ranging from 15 percent from oil produced from the uplands, to 18¼ percent from production from submerged lands.

CIMA, which wholly owned by the American Independent Oil Company, has been capitalized initially at 7 million pesos(about $1 million). Davies will serve as president and director, and other officers include N. P. Isenberger, vice president, a petroleum geologist; Chandler Ide, secretary and treasurer; and Raymond W. Ickes. American Independent Oil Company itself is composed of ten independent American oil operators who in 1947 joined forces to enter the international field.

Pemex issued a public statement after signing of the CIMA contract making clear that "Petroleos Mexicanos shall have at all times the supervision and control of the works which the contractors perform, which works will cease on the termination of the drilling of each well. Pemex will carry on the exploitation of the wells."

Imperial Oil Marks Record Year In Production, Marketing

During 1948 Imperial Oil Company found more crude oil, produced more oil, transported, refined, distributed and marketed more oil and products than ever before, according to the company's annual report.

Two more "T-2" type ocean tankers, and three lake tankers, were put into service during 1948. One of the lake tankers, the "Imperial Sarnia," is the largest tanker ever built in a Canadian shipyard and is the largest tanker on the lakes under Canadian registry.

An eight-inch pipe line was laid from Nisku to the company's Edmonton refinery and progress was made in planning for a 16-inch line which will be laid from Edmonton to Regina. Tank cars in service reached a record of 4711, and more than 150,000 car loads of crude oil and petroleum products were moved.

During the year exploratory footage drilled by Imperial in Alberta totalled 121,522 feet. Development drilling by Imperial and subsidiaries in western Canada totalled 671,498 feet. In the development of known fields, 119 wells, of which three were dry holes, were drilled.

ECA Builds Foreign Competition for U.S. Oil Industry

By HENRY OZANNE, Staff Writer

GREAT BRITAIN'S declared intention to increase its petroleum production and refining capacity for the export of oil products to dollar markets as well as throughout the sterling area makes the Economic Cooperation Administration program the single most important and controversial issue facing the American petroleum industry.

The issue is this: To what extent should the U. S., with its own taxpayers' funds, finance this vast expansion of European oil facilities to the detriment of American oil investments abroad? American industry leaders have voiced bitter criticism of ECA's plan which they contend will

1. Use about $1 billion of U. S. capital in the next year to build up foreign —chiefly British—petroleum productive and refinery capacity which, at the end of ECA in 1953, will result in a huge over-expansion of oil facilities in Europe and the Middle East with the consequent serious upset to world petroleum economy.
2. Create, worldwide, a competitive industry in foreign hands that has announced its intention to grab dollar oil markets wherever it can and virtually wipe out an American oil export industry.
3. Through the loss of world markets outside the U. S., cause the dumping of oil on this country followed by further and further cutbacks in our domestic industry and increasing threats to the whole petroleum price structure.
4. Dangerously threaten American investments in Middle East oil by financing British production expansion there at a faster rate and preferentially to the American industry.
5. Make the American petroleum industry—simply by virtue of the fact that oil represents 20 percent of the value of the ECA program—the "fall guy" for the government's help to other industries not so competitively placed.

The issue was highlighted last month when Britain revealed that it is pushing ahead "on one of the United Kingdom's most ambitious and important recovery projects—an eightfold increase in her oil refining capacity." The capital costs of seven plants now under construction in Britain will be $500 million, "and when finished they will be treating nearly 20 million tons of crude oil a year, compared with little more than 2½ million tons in 1947. And work is being pushed ahead so rapidly that by next year annual throughput should have reached 8 million tons of crude oil."

The British Government further announced:

"Purchases from the U. S. A. will be cut down. At the same time British oil companies will be able to play an increasing part in supplying sterling areas, Western Europe, and other parts of the world with petroleum products which can be paid for in sterling, not in dollars."

As to producing programs, the British government said:

"British concerns are heavily interested in Middle East oil fields, which are rapidly increasing production. British companies also are producing in Latin America, West Indies, Indies, and elsewhere. Including the Royal Dutch Shell Group, a partnership of British and Dutch undertakings, oil production of British concerns rose from 46 million tons in 1946 to 54 million in 1947, and probably was 64 million last year. By

The American oil industry, through taxation, is furnishing ECA with dollars to expand a British petroleum industry which may one day flood the world's markets.

1953 it will possibly be double the 1947 total."

Walter J. Levy, chief of ECA's petroleum branch, recognized the danger to the American petroleum industry when he said in a recent speech in New York: "It is obvious that very grave and serious problems now confront and are likely to remain with the American oil industry."

One leader of the industry replied: "In a free economy such as ours we have no complaint at any competition the British or any other people can give us. But it is quite different when our own dollars are used to create a competition that does not even exist and which may eventually destroy our own industry. And note, further, that the British government is a heavy owner of the British petroleum industry."

The nature and size of this competition can be summed up in several sets of figures. In 1949 the dollar value of petroleum equipment needed by the 16 participating countries in the Marshall Plan is put at $573 million, of which $192 million is scheduled from dollar sources. In 1950, the total value is estimated at $551 million, of which $206 million is to be dollar sources. One-third of the equipment needed for 1950 will be for the United Kingdom, of which more than 75 percent is for Britain's overseas use. In 1950 one-half the petroleum budget of ECA will be for refining purposes, and 23 percent for petroleum equipment.

The Office of European Economic Cooperation has estimated that 54 million tons (394 million barrels) of crude oil and products, valued at $1374.5 million must be imported by the 16 Marshall Plan countries during the fiscal year 1950, of which 23.2 million tons (169 million barrels), valued at $661 million must come from sources requiring dollar payment. ECA is expected to scale this down about 14 percent.

Yet industry economists hold that by 1953, at latest, there is likely to be a decided surplus of dollar oil, both crude and products. Even by 1950 it is expected there will be sufficient dollar oil available to satisfy all the import needs of the Marshall Plan countries without increasing the quantity of imports required from the U. S. above that needed for 1949.

In 1938 the Western Hemisphere supplied 29 million tons of petroleum to Europe, but in 1949 it will supply only 26 million tons. The share of Western Hemisphere oil will decline from 76 percent of Europe's imports to about 54 percent during the five-year ECA program. Middle East Shipments to Europe gained from 9 million tons in 1938 to 22 million tons in 1949, the Middle East share rising from 24 percent to 46 percent over that time. By 1953 it is planned for the Middle East to supply 62 million, or 74 percent, of the total petroleum requirements of Europe.

Refinery Expansion

One of the greatest expansions in the foreign oil industry will be that of plant capacity within and outside Europe. Refinery expansion outside Europe by British, French and Dutch interests will provide the most important source of foreign exchange income. The vast British plan will result in the increase of crude and products by about $1 billion a year by 1953. This is to be achieved with the investment of the equivalent of $1½ billion to $2 billion, of which about one-third must be dollar funds.

European refinery capacity will be up from 19.3 million tons in 1938 to 27.5 million in 1949, and to 33.5 million by 1950. It is expected to reach a peak of 62.6 million tons by 1953.

Many government as well as industry authorities predict a world-wide unbalanced oil economy by 1953 with the likelihood of huge surpluses for Europe because of stepped-up refinery capacity outside Europe.

ECA Petroleum Chief Levy said that Europe probably will still have a dollar shortage when ECA ends in 1953, and thus the problem facing the American companies is one of maintaining outlets for dollar oil in Europe even though the dollar resources of the importing countries are severely limited and even though sterling oil will compete with dollar oil for such outlets. He offered no concrete way of solving this problem.

However, Levy holds that ECA is a necessary stabilizer in European and world oil economy. "Without ECA," he says, "the obvious thing for a country like Great Britain to have done would have been to develop its one great imperial asset, oil, for all it is worth. Therefore, the European countries would have had no alternative but to buy British oil to the limit of possibilities. There then would have been no chance to work out a solution in good time to permit the American oil industry, with foresight and judgment, to maintain its important and vital role in the oil production and marketing centers overseas."

Industry economists, on the other hand, point out that the basic idea of the Marshall Plan was to rehabilitate the participating countries, not to displace American industry or to set up other countries in a preferred petroleum position.

The solution is almost wholly in the hands of Congress as to the size of appropriations authorized, and with ECA itself which can scale down requirements as submitted by the participating nations to realistic levels and non-competitive scales.

TABLE 1
Petroleum Equipment Programs Estimated by the Nations Participating in ECA
(value in thousands of dollars)

TYPE REQUIRED	1950			1949		
	Dollar Sources	Non-Dollar Sources	Total	Dollar Sources	Non-Dollar Sources	Total
Drilling	54,301	47,250	101,551	38,906	30,995	69,861
Well Casing	13,800	13,249	27,049	17,400	16,800	34,200
Refining	122,640	186,843	309,483	84,877	116,414	201,291
Transportation and Distribution	300	840	1,140	10,957	71,923	82,880
Storage	11,816	55,260	67,076	9,104	62,287	71,391
Pipe Lines	2,645	40,850	43,495	25	19,800	19,825
Miscellaneous	.....	800	800	31,271	62,429	93,200
	$205,502	$345,092	$550,594	$192,540	$380,608	$573,148

TABLE 2
Volume of Petroleum Required from Dollar Sources (Revised Downward)
(In millions of metric tons)

	ECA Estimate of Requirements	Total	Estimated Availability		
			U.S.	Other West. Hem.	Mid. East
1950:					
Crude Oil	11.0	13.5	0.5	2.5	10.5
Products	11.0	12.0	4.0	5.5	2.5
	22.0	25.5	4.5	8.0	13.0
1949:					
Crude Oil	8.0	8.5	0.5	2.5	5.5
Products	12.5	12.5	4.0	5.5	3.0
	20.5	21.0	4.5	8.0	8.5

TABLE 3
Exports of Crude Oil and Products
(In thousands of barrels)

	To 16 Countries in the Marhsall Plan	To Other Countries	Total
1938	77,147	108,566	185,713
1945	107,353	65,419	172,772
1946	58,963	77,838	136,801
1947 (9 months)	41,648	69,447	111,095
1948 (9 months)	24,603	64,546	89,149

TABLE 4
The Flow of Crude Oil and Products to Europe by Sources of Supply
(In millions of metric tons)

SOURCE	Fiscal 1953	Fiscal 1949	Fiscal 1947	Fiscal 1938
U.S.	2.0	4.5	8.0	11.0
Other W. Hem.	14.0	21.5	18.0	18.0
Total W. Hem.	16.0	26.0	26.0	29.0
Middle East	46.0	22.0	12.0	9.0
Grand Total	62.0	48.0	38.0	38.0

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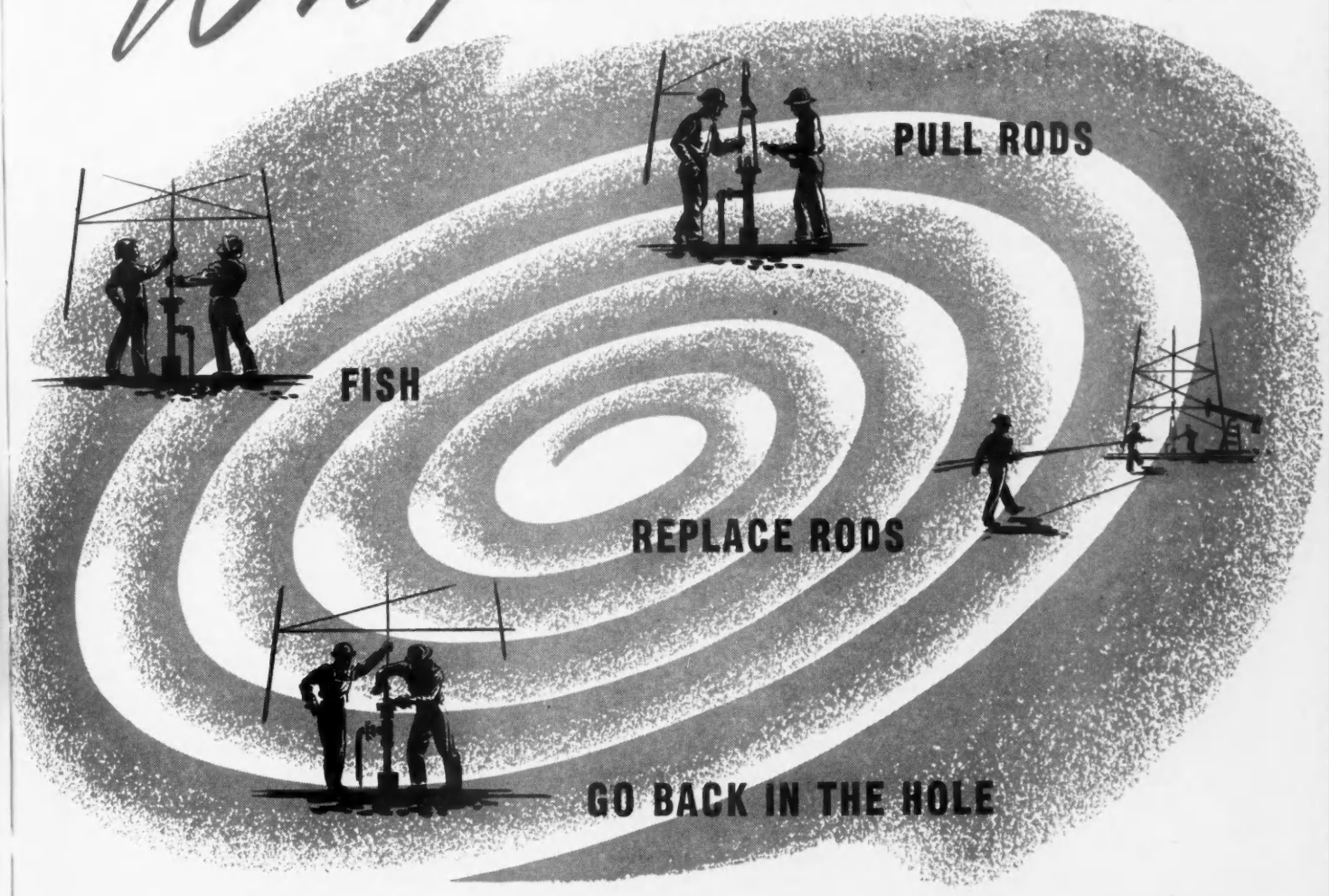

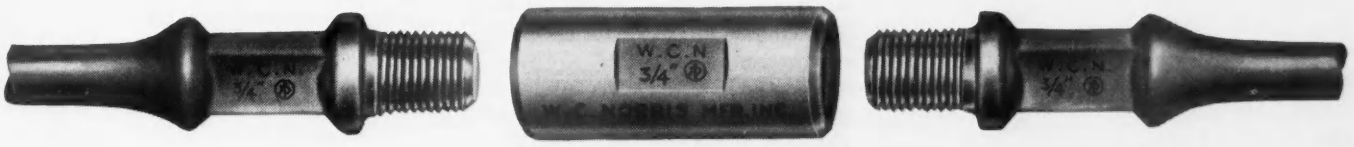

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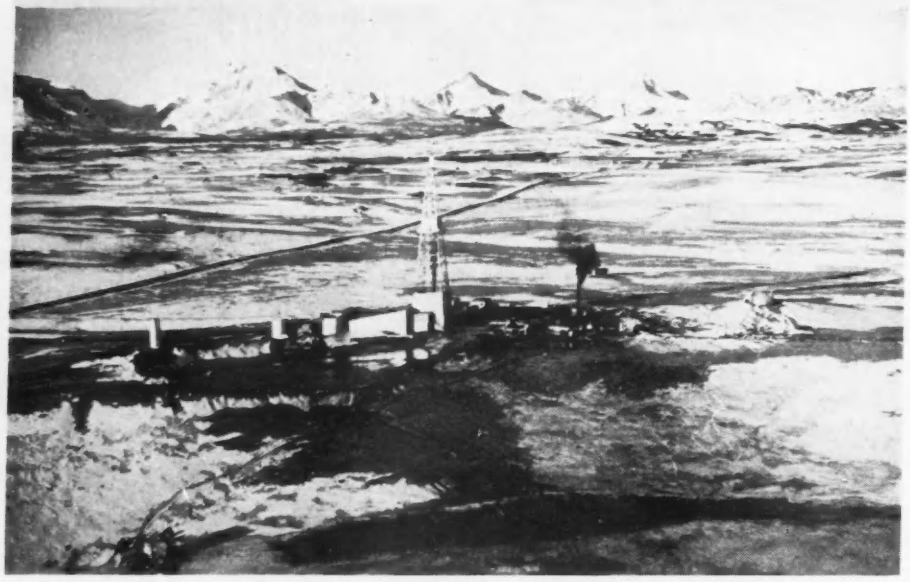
Gulf "Engineers" Tallest Shoe-to-Surface Cement Job



Canadian Gulf Oil Company's Walter Marr 1, in the new Pincher Creek area, Alberta Province, Canada. Canadian Rockies are in the distance.

By JOHN A. HALL
Vice President, Research and Development, Weatherford Oil Tool Company, Inc.

THROUGH CAREFULLY engineered planning, and technique built up by progressive improvements in "shoe-to-surface" cementing, a Canadian well has established a record for a successful fluid and gas-tight job. Techniques included use of a new cementing head allowing pipe to be reciprocated even while releasing plugs; conditioning of the hole with scratchers and centralizers with very short travel between lugs; use of a gel slurry in mixing cement; and progressively increasing weight of cement mixture during actual cementing operations.

THE world's tallest single-stage "shoe-to-surface" cement column has been "engineered" in the Pincher Creek field of Alberta, Canada, where Canadian Gulf Oil Company set 5500 feet of 9 5/8-inch casing in a 12¼-inch hole at Walter Marr 1. This is the second well drilled in the area, which was discovered by Canadian Gulf about a year ago.

Among the unique features of this cementing operation was that the operator was able to reciprocate the 5500-foot string of pipe for eight minutes after clean cement had reached the surface and it was still free when reciprocation was discontinued and the brake chained down.

The job was undertaken primarily to obtain a fluid-tight and gas-tight cementing operation; to anchor the casing to the formation and to wrap it in cement from top to bottom so as to provide a protective sheath against corrosive and erosive action and internal wear; and to afford additional future well protection in the event of failure or leakage of the oil string. Plans provide for cementing the oil string casing from approximately 12,300 feet up into the base of the 9 5/8-inch casing. This protective feature is important in the Pincher Creek area since gas in the producing formation contains 9 percent hydrogen sulfide and 8 percent carbon dioxide, both of which may be corrosive.

Success of the operation also serves the broader purpose of making available to the industry the technical and practical information which made this unique cementing operation possible. It demonstrated that tall, single-stage "shoe-to-surface" cement columns can be set successfully without sticking the pipe and that even long oil strings can be set with safety in a single-stage cementing operation when the operator elects to eliminate either a part of or all of the surface casing to cut down drilling costs.

Gulf engineers and others connected with the job are to be complimented for the success of the operation which was due to good organization, a complete understanding of important engineering principles involved and the use of proper equipment. Despite the extreme cold which plummeted the mercury to nearly 40 below while preparing for the job, there was no letdown on the part of the well and cementing crews. Fortunately, during actual cementing, the weather moderated to a "high" of 16 above.

High cement columns have been attempted at other shoe-to-surface jobs. These failed because of high cement viscosity resulting in higher placement pressures as well as failure to build an adequate filter cake to support the high column of cement which induced lost circulation. Techniques have been recently developed to counteract these unfavorable conditions.

Cementing techniques employed at the Marr well were the results of work originating in South Louisiana, broadened and more perfectly worked out in Venezuela, and still further developed and refined in the fields of West Texas, New Mexico, South Texas and again in South Louisiana. The unique requirements of each of these areas contributed to the progressive improvement of the techniques applied.

To accomplish the operations necessary to the methodical progression of the

job the following basic four-point program was mapped out:

First, for mud and hole conditioning purposes, the technique of progressive circulation was employed while running casing at the following depths: 2048 feet; 3225 feet; 4464 feet and 5500 feet, which was the setting depth.

Second, a newly designed cementing head was used which was developed in Venezuela (Figure 1). This equipment permitted continuous reciprocation of the pipe and continuous circulation of the cement while releasing the plugs. The use of this head definitely contributed to the success of the job. Had it been necessary to stop pipe reciprocation and circulation in order to release the plugs, it very likely would have resulted in stuck casing and the failure to reestablish circulation due to dehydration and stiffening of the slurry in the open hole.

Third, spiral centralizers and scratchers were used to recondition the walls of the hole. Fifty-seven spiral centralizers and 316 reversible scratchers with five-inch bristles were spaced at approximately 96- and 16-foot intervals, respectively, on the outside of the 9 5/8-inch casing throughout the open hole. The centralizers extended up into the bottom of the conductor pipe.

In order to increase scratching action and to maintain the cement in suspension the scratchers were given a three-inch travel between the lugs instead of the customary two feet. This was to prevent the flash dehydration of cement and maintain a maximum circulating annulus. The scratchers also were installed alternately in opposite directions in order to create criss-cross scratching pattern for better mud cake and dehydrating cement removal from the walls of the bore hole.

The reversible scratchers and spiral centralizers were spaced throughout the open hole in order to keep the pipe free, assuring a clean column of cement by cleaning out hole enlargements and removing mud cake so as to eliminate channeling as the cement top rose to the surface. These were essential factors in order to build strong cement walls as a foundation to support the 5500-foot column of cement.

The fourth and final point in the program concerned actual cement mixing which was carried out in an organized and planned procedure (Figure 2).

Five cement trucks were used on the operation. All were completely rigged up and their equipment checked and tested before the casing was started in the hole.

A 2 percent bentonite gel slurry was prepared in 1000 barrels of water which was maintained at temperatures ranging between 40 and 50 degrees for mixing the cement. A 500-barrel emergency water tank also was available, and both tanks were connected by a four-inch line.

Water Lines

From the 1000-barrel, 2 percent bentonite tank and the 500-barrel water tank, five individual four-inch water lines were laid to the five cement trucks to insure an adequate supply of water for cement mixing.

A total of 2280 sacks of high temperature, slow-set U.S. cement weighing 94 pounds per sack, and 1900 sacks of Canadian portland cement weighing 87 pounds per sack were distributed between the five trucks for mixing.

The first 3880 sacks were mixed at an average weight of 13.36 pounds and the last 300 sacks at an average of 14.96 pounds. The reason for using the lighter slurry first was to prevent the forming of an uncirculatable cement column resulting from water loss to the formation. The fact that the uncontaminated cement estimated at 200 sacks, which returned to the surface weighed 14.5 pounds per gallon, which was 1.14 pounds heavier than when first mixed, demonstrated the advisability of this technique.

When the cement mixing was begun the trucks were added one by one as the maximum mixing output of each truck was reached. The cement lines from the five cement trucks pumped into a four-inch manifold which was connected to the five-inch cementing standpipe and four-inch steel hose.

The weight of the mud in a 1000-barrel reserve tank was increased from 10.7 to 12 pounds so as to overcome the resistance of the 10.7 mud already in the hole when the plugs were pumped

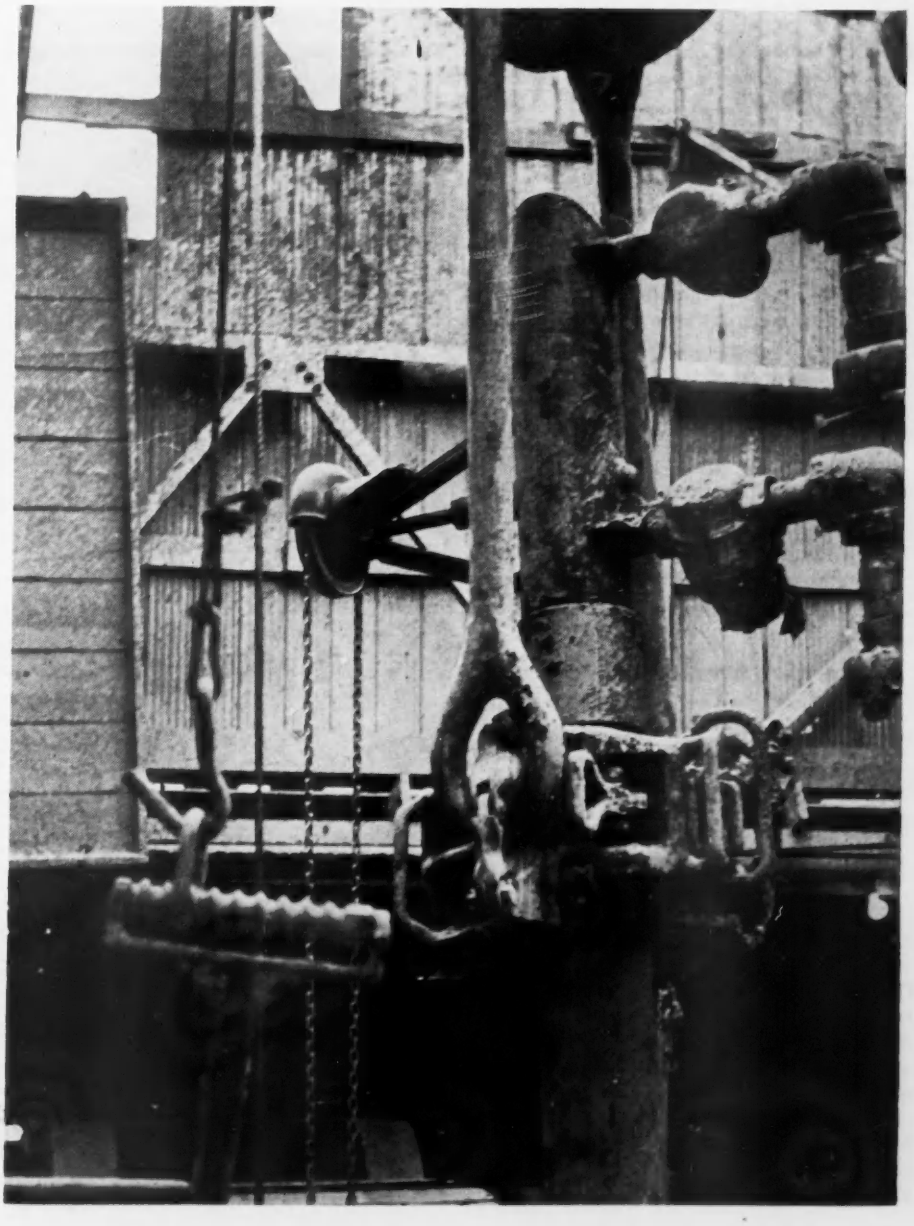


FIGURE 1. New high-column cementing head used in setting 5500 feet of 9⅝-inch pipe in the tallest single-stage "shoe-to-surface" cementing column operation so far attempted. In operation, as last five sacks of cement are mixed, plugs are released without stopping either (a) the casing in the cement or (b) the circulation of the cement in the open hole. Release shaft is screw-jacked out in about ten seconds as pipe is moved upward. Then plugs are pumped out of head with mud through top hose as last of the cement is pumped into pipe.

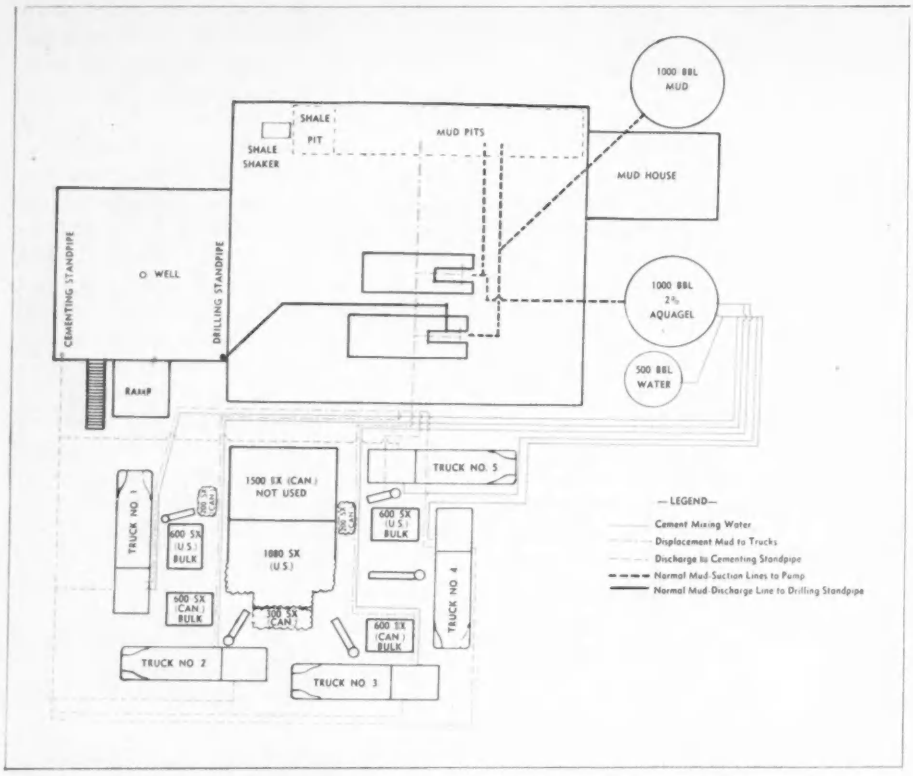


FIGURE 2. Layout for mud circulation, cement mixing and pumping, and displacement of cement with heavy mud, showing five cement trucks, connecting lines, reserve pits, etc.

down. This also minimized possible circulation slow-up during the latter stages of the job and maintained a more constant speed of circulation at lower pressures.

When the 395 barrels of 12-pound displacement mud was pumped into the hole the pump pressure indicated 1000 pounds per square inch which gradually levelled off to 750 pounds per square inch after the pumps were stopped.

The mud lines and pumps were rigged up to pull mud either from the pit or from the 1000-barrel reserve tank and to supply the cement trucks with displacement mud, as well as being connected to the two standpipes and hoses in the derrick.

In order to prevent the cement column from moving down the hole as a result of lost circulation or water loss, the 12,195-foot hole was plugged back to 5910 feet prior to running the 9 5/8-inch string. The 13 3/8-inch conductor pipe had been set at a depth of 490 feet and was cemented to the surface.

The pipe was reciprocated on a 30-foot stroke at the beginning of the job and this was gradually reduced until it was being reciprocated at an 18-foot stroke at the conclusion of the operation.

Before starting the cement into the hole and with the pump pressure at 150 pounds per square inch on the up-travel of the casing and 200 pounds per square inch on the down-travel (the casing being reciprocated on a 30-foot stroke) the weight of the casing according to the weight indicator was 200,000 pounds on the up-travel and 170,000 pounds on the down-travel, representing a differential of 30,000 pounds and indicating an approximate 15,000 pounds frictional drag in either direction.

When the 5500-foot cement column was circulating at the surface there was a weight indicator reading of 140,000 pounds on the up-travel and 100,000 pounds on the down with a fairly consistent pump pressure of 1000 pounds per square inch. This, of course, represents a differential of 40,000 pounds. When the pumps were shut off and the pipe was stationary the casing "crawled downwards" and increased in weight to 170,000 pounds. This final weight when compared to the 140,000 pounds up-travel on the last reciprocation indicates that friction and resistance of the circulating cement column was assisting in lifting the casing to the extent of 30,000 pounds.

With the empty blocks weighing 10,000 pounds and the last down-travel of the casing indicating 100,000 pounds, there remained a 90,000-pound safety factor with which to move the pipe downward in the cement while pumping. There was no indication of any tendency towards sticking of the casing in the cement when reciprocation was stopped and the brake chained down.

Total time consumed in the over-all operation amounted to 3 hours, 25 minutes, including 2 hours, 25 minutes, for mixing cement and 1 hour for pumping the plug to bottom.

ACKNOWLEDGMENT

The author wishes to thank Canadian Gulf Oil Company for information and assistance in the preparation of this article as well as permission to publish it.

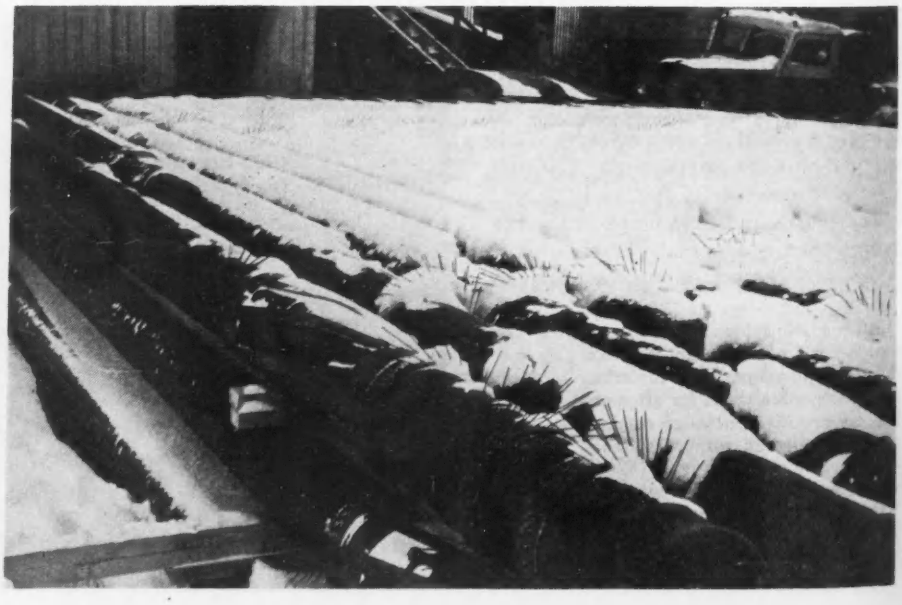
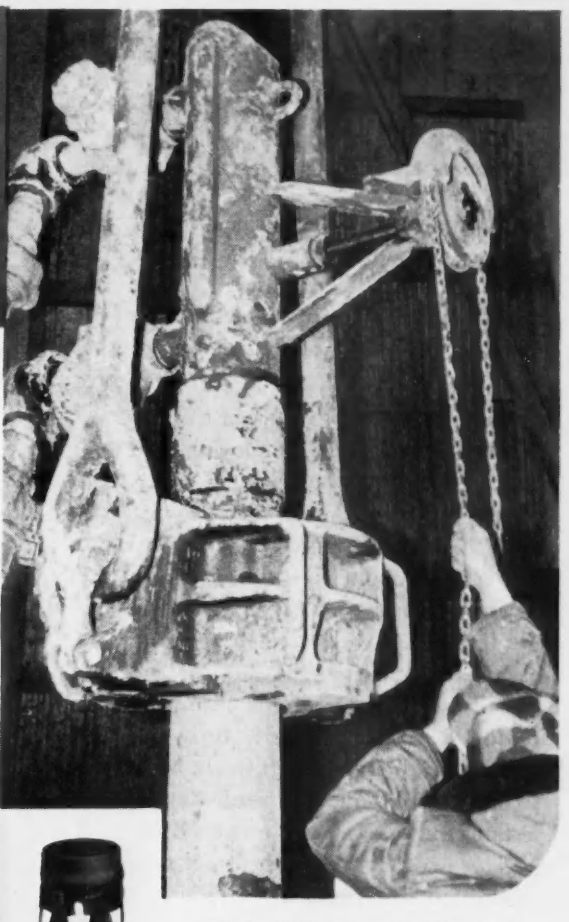


FIGURE 3 Portion of the 57 spiral centralizers and the 316 reversible scratchers installed on 5500 feet of 9⅝-inch casing at Canadian Gulf Oil Company's Walter Marr 1. In order to obtain more effective and more constant scratching in both mud and cement, scratchers were alternately spaced in opposite directions to achieve a "criss-cross" scratching pattern and only three inches instead of the customary two feet of travel were given the scratchers. First joint in top layer with the concentration of scratchers is the shoe joint.

THE 3 AS ONE TOOL



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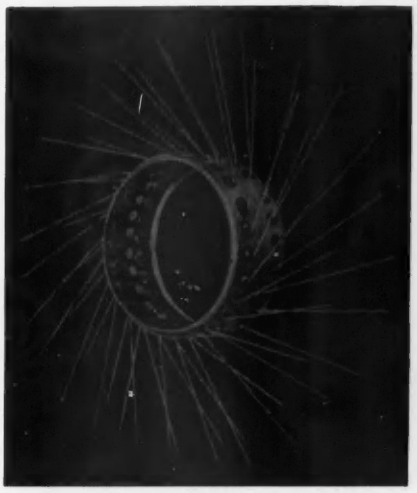
3. **The Weatherford Spiral Centralizer . . .** 57 were employed according to the Weatherford Formula.



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- This job definitely established the continuous circulating and reciprocating features of the Weatherford Cementing Head, and proved it to be an indispensable companion tool to Scratchers and Centralizers on single stage, "shoe to surface" cement columns.
- Weatherford equipment and technique were fully employed.
- Pipe was still free in cement at end of job.
- 200 sacks of clean cement were circulated back to surface.
- 4,180 sacks of cement were used.
- The building of strong cement walls by the Scratchers and Centralizers at all zones served as a foundation for tall cement columns.

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When Well Conditions Demand A

NOT only does the Baker Model "D" Retainer Production Packer take care of the "every day," simple installations, but it is adaptable to many of those previously difficult or impossible applications.

This is due first to the construction of the Packer itself, employing two sets of opposing slips, with a Hycar packing element between them, so that the Packer virtually becomes a part of the casing, cannot be moved up or down the casing, and prevents fluid or gas from passing between the packing element and the casing. When the Setting Tool, used to set the Packer, is removed from the well, only the smooth-bore Packer is left in the well, securely packed-off, and ready for selection and use of the proper Baker Packer Accessory Equipment to meet production requirements.

ACCESSORY EQUIPMENT IMPORTANT

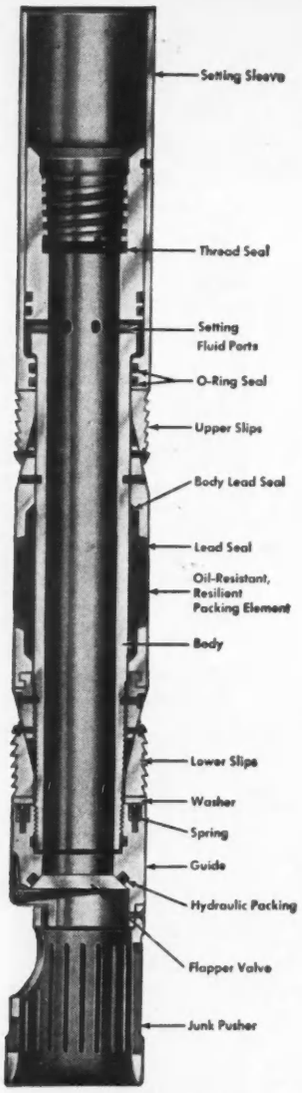
It is the complete line of Accessory Equipment that is responsible for the outstanding adaptability of Baker Packer installations to produce one or more zones, simultaneously or separately—through tubing or casing—and often with flexibility to permit production changes without pulling the tubing string.

One interesting and useful accessory unit is the Baker Tubing Seal Nipple, Multi-V Type (Product No. 448-D) which is an important element in many Packer installations to effect a fluid-tight seal in the annulus between the tubing string and the internal smooth bore of the Packer. This unit permits movement of the tubing string, either up or down, over the length of the Packer bore; and, for additional movement more than one Multi-V Tubing Seal Nipple may be used, as shown in Figure 1 on the opposite page.

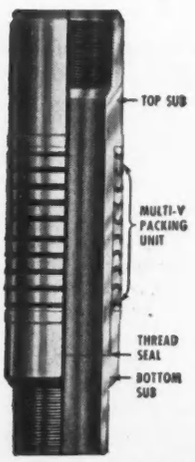
CONVENIENT LATCHING SUB

The Baker No Left Turn Latching Sub (Product No. 473) is positioned in the tubing string just above the Tubing Seal Nipple. This ingenious device does not effect a seal, but provides a quick-engaging, positive hold-down for the tubing production string, and holds the Tubing Seal Nipple in proper position in bore of Packer where it cannot be moved upward or downward by expansion or contraction of the tubing string.

Inasmuch as no "set-down" weight is required for operation of this Sub, the tubing can be suspended in tension, if desired, so that pressure bombs (and other devices) may be dropped readily through the tubing. Operations are not handicapped by "corkscrewed" tubing which often results when set-down weight is applied to conventional type packers.



Baker Model "D" Retainer Production Packer Product No. 415-D



BAKER TUBING SEAL NIPPLE, MULTI-V TYPE, which effects a fluid-tight seal between the tubing string and the bore of the Packer.

APPLICATIONS ARE MANY AND VARIED

In addition to the fact that the Baker Model "D" Retainer Production Packer is used for single-zone or multiple-zone production applications, it is ideal for isolating casing, for salt water disposal, for acidizing, re-pressuring, and many other applications.

Other features which appeal to veteran production men are its Complete Drillability—Resistance to High Temperatures—Corrosion-Resistant Construction—Freedom of the Tubing from the Packer—and Positive Anchoring Against Upward or Downward Movement.

Descriptions, illustrations and specifications are in your 1948 Baker (or Composite) Catalog; a new brochure covering the Baker Retainer Production Packer will soon be off the press ready to mail at your request; and Baker representatives in every active area are anxious to serve you.

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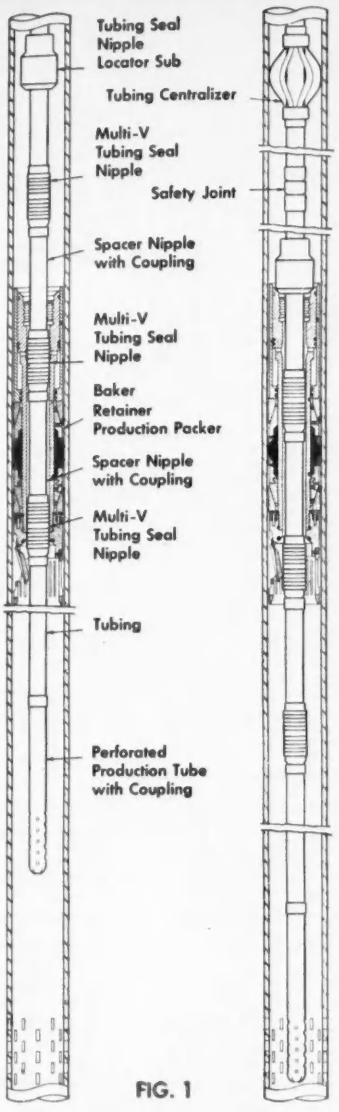


FIG. 1

FIGURE 1—(left)

This single-zone installation is recommended where it is necessary to compensate for variations in the length of the tubing string, and to prevent excessive weight being imposed upon top of Packer when extreme increases in bottom hole temperatures cause expansion of tubing.

Three Baker Tubing Seal Nipples, Multi-V Type, are used, and spaced so that one Nipple is always sealed off in the bore of the Packer. The desired length of the tubing string is determined, to permit proper spacing of the Multi-V Nipples in the Packer and allow for proper connection at the tubing head. The tubing string is run into the well until the Baker Locator Sub contacts the top of the Retainer Production Packer. The tubing is then raised to remove the Seals from the Packer, to permit circulating and unloading the mud from the well. When the well has been unloaded, the tubing is set down and the final Christmas tree connections made.

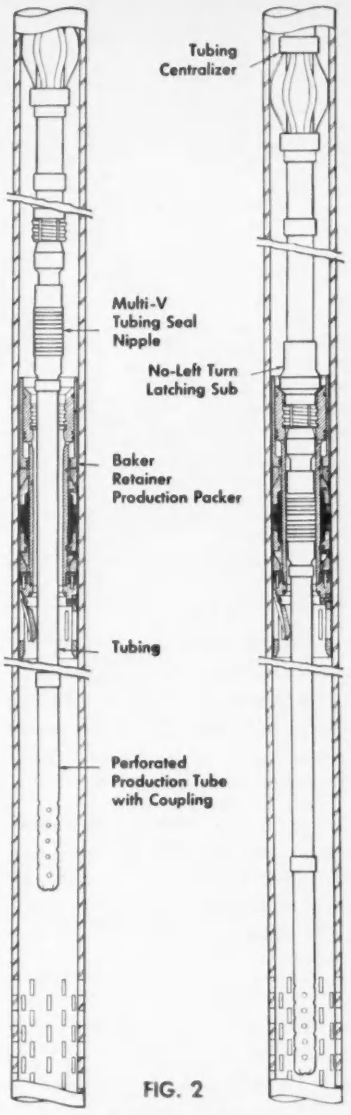


FIG. 2

FIGURE 2—(center)

This hook-up is for producing a single zone with the production string anchored to the Packer, an advantageous feature when it is desired to: (a) produce the zone by pumping, while keeping the production string in tension; or (b) produce the zone by flowing without having to impose excessive weight on the Packer in order to hold the Tubing Seal Nipple properly positioned in the Packer bore; or (c) high pressure injection of gas or fluid for re-pressuring or secondary recovery.

The production string is run in the casing until the No Left Turn Latching Sub rests on top of the Packer. This is indicated at the surface by a drop in weight recorded on the strain indicator or the weight indicator. The production string is then raised approximately five feet, and in this position the zone may be washed and brought in, if it will flow.

FIGURE 3—(right)

This two-zone hook-up permits washing the upper zone and unloading the annulus; or the upper zone may be killed through the tubing without running a side door choke on a wire line. The casing head used must pack off while the tubing is being raised or lowered. The Packer is set close below the upper zone, and the production string (made up as shown in Figure 3) is run in until the Locator Sub rests on top of the Packer, indicated by a drop in recorded weight on the strain indicator.

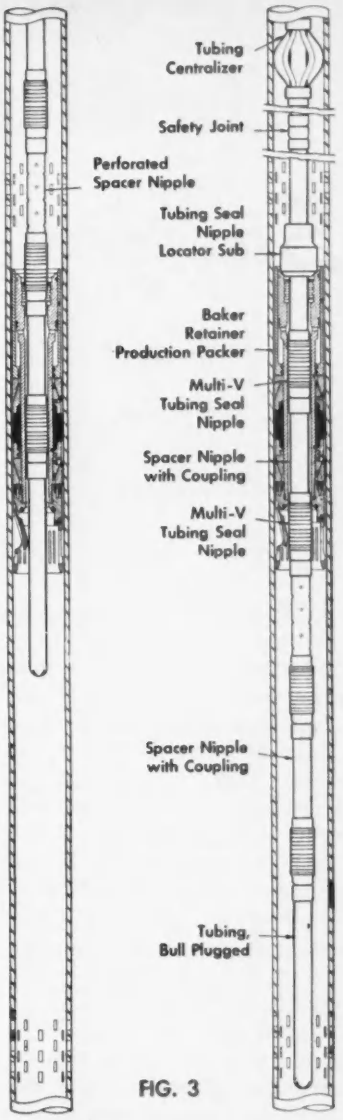


FIG. 3

To wash the upper zone, or to unload the annulus, the string is raised about 8 feet to bring the Perforated Spacer Nipple above the Packer, but with the lower Tubing Seal Nipple inside the Packer bore. After the upper zone is brought on production through the casing annulus, the production string is lowered until the Locator Sub rests on top of the Packer. Weight of 10,000 pounds, or more if desired, may be set on the Packer, and the lower zone brought in through the tubing, by swabbing if necessary. To kill the well later, the lower zone is killed through the tubing; the production string raised (left view) and the upper zone killed. The production string is the removed from the casing.

Product No. 415-D

Retainer Production Packer

The Search for Oil in *Switzerland*

By DR. J. KOPP

THE AUTHOR holds that more exploratory drilling may yield commercial oil production. Many previous failures are believed to be the result of geologically unfavorable locations and of lack of technical skill.

This article is from a paper presented before the 69th annual meeting of the Upper Rhine geological society at Heidenheim-on-the-Brenz, May 7, 1948.

INDICATIONS of hydrocarbons are fairly widespread in Switzerland. In the Molasse basin a petroliferous sandstone outcrops between Geneva and Aaran. Natural gas has been observed in various lakes and tunnels in the sub-Alpine zone. There are natural gas shows at the east end of the Langensee on the south side of the Alps. In the western part of the folded Jurassic region are asphalt beds as well as oil sands.

De Saussure described the bituminous Molasse of the Geneva Canton in 1787, and an investigation of its potential yield was undertaken at the beginning of the last century. The oil sand was exploited by galleries, and the product was used partly as a mastic for road surfacing and partly when distilled as an oil in the Swiss watch industry.

The oilsands of the West Canton of Geneva were closely studied during World War I by Heim and Hartmann. They came to the conclusion that they were dealing with oil from a primary deposit in the Lower Aquitanian. Their further researches were on the oilsands of the Cantons of Neuenberg and Waadt on Lake Neuchatel and at Chavornay. They showed that the practically dry holes drilled at Chavornay in 1912 were unfavorably located in a syncline. Other oil sands investigated were on the Aare, at Fulenbach, west of Olten, and at Aaran. All these oil shows were in the Aquitanian Molasse and are definitely primary types of oil sands.

In order to complete Heim's research, which was broken off, Kopp undertook in 1934 to investigate the area west of Olten, where the flat, closed St. Urban anticline lies to the south of the open Wynan anticline in which there is an oilsand. This structure was investigated by pitting. The continuation of prospecting on a broader basis was taken over by an official commission which investigated the whole of Western Switzerland during 1935-37. The sub-Alpine Molasse zone was included. Subsequently, the scarcity of oil products during World War II led to the undertaking of further shallow drilling in the Molasse area, west of Geneva.

Some deep tests have been drilled on foreign initiative, independent of the state search. Anton Raky drilled to 4900 feet in sub-Alpine Molasse in the Tuggen Plain at the upper end of Lake Zurich. The well was on a presumed fold but entered beds of the overthrust Molasse. Oil and gas shows were observed in the Chattian but no production was obtained.

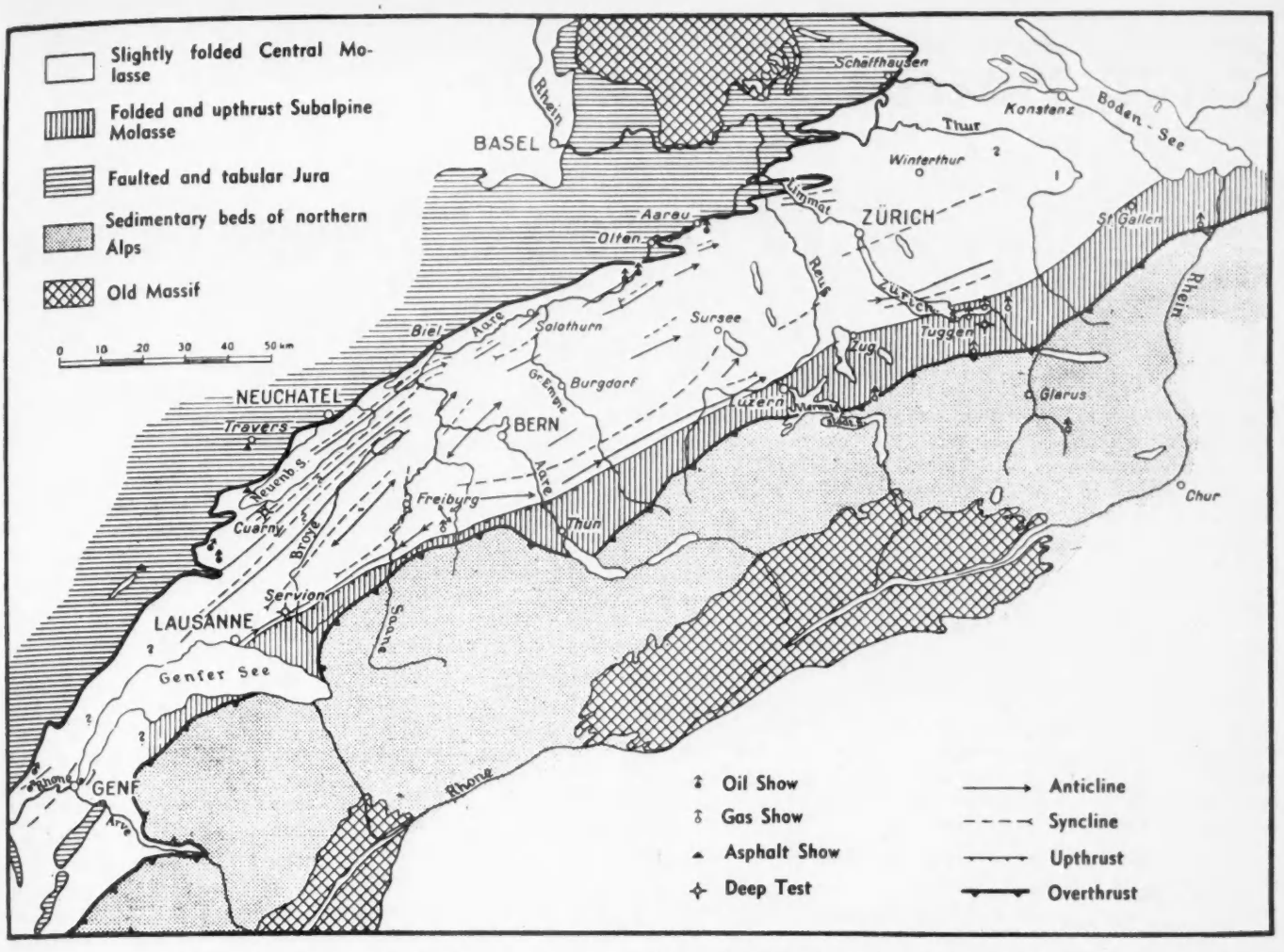
Western Test

Shortly before World War II a Belgian, F. J. G. Vingerhoets, started prospecting in Western Switzerland. The first well was put down on the Cuarny anticline at Yoerdon, not far from Lake Neuchatel. It penetrated 1310 feet of Chattian Molasse with some oil and gas horizons. Because of a water shutoff failure, bailing tests are not thought to have given true information on the productivity of these formations. The test was abandoned at 6684 feet in Lower Dogger beds without any true oil production.

A second test was at Servion above Lausanne, on the first anticline of the western Molasse. It was planned to take this to the Rupelian at a depth of 9000 feet, but technical trouble caused the well to be stopped in the Aquitanian at 4296 feet. The manner in which these three deep tests were located and drilled provide no true information on Swiss oil possibilities. Still less is given by some shallow tests for oil and gas located by diviners in various parts of Switzerland. A well drilled during World War II at Leissy in Geneva Canton penetrated nine oil sands in the Chattian with a content of 2 to 3 percent by weight of oil, but no production was obtained. The well stopped at 879 feet before reaching the bottom of the Tertiary.

Gas wells drilled to 327 feet in the alluvium of the Rhine Valley above the Bodensee have given no commercial production. The only commercial natural gas production in Switzerland is at Tenero on the Langensee. The gas collected from the natural springs is compressed and used as motor fuel.

The investigations carried out by members of the Petroleum Export Commission in the sub-Jurassic zone between Aaran and Solothurn showed that the oilsand is not in the Aquitanian but in the Chattian Molasse. The belief that the oil did not originate in place, but migrated to its present position has been confirmed. It is presumed that the oil originates from the Rupelian marly



Geologic provinces of the Swiss Molasse, showing known structural conditions and points at which indications of oil or gas have been noted.

clays in the deep Molasse trough to the south. Relatively favorable conditions for oil accumulation were found in the St. Urban anticline, so this area is a first choice for exploratory drilling in Central Switzerland.

The investigation of the sub-Jurassic zone from Solothurm to the Neuenburger See led to more exact delineation of numerous Molasse structures. Oil shows were not discovered, however.

At a number of places in the Molasse zone between the Neuenburger See and the Genfer See oil impregnations were noted in the Chattian. Rupelian beds could not be found at the Jura margin. The asphalt impregnations in the Cretaceous of the Cuarny test and the Mormont anticline at Eclepens station are infiltrations of Tertiary oil through fissures. It is no longer possible to support the view that oil has formed at the edge of the Jura only in local basins which resulted from structures already present in Oligocene times acting as ridges behind which, in lagoonal type lakes, favorable conditions for oil formation prevailed. It is more likely that the oil in the Chattian reservoir rocks of the sub-Jurassic zone came from deep Stampian beds of the inner Molasse trough. The fact that so far no oil indications have been found in the Rupelian of the sub-Alpine zone of Western Switzerland is not against the view, for it has been found by experience that in areas strongly deformed by tectonics no further oil is frequently given by the mother rock. Years ago geologists remarked that the Inner Schlier of Austria, which corresponds to the Lower Stampian of the sub-Jurassic zone, should be considered as a source rock. On this basis, possibilities of oil production should be sought not so much in the sub-Jurassic zone as in the central Molasse where accumulations could be found not only in anticlines but also in stratigraphical continuities.

Anticline Established

Recent tectonic investigations have shown a series of gentle folds in the central Molasse of the Cantons Bern, Freiburg and Waadt. A primary anticline has been established along the Alpine margin from the Aare Valley to the Senfer See. There is a definite apex in the neighborhood of Alterswil in the Freiburg Canton. The possible petroliferous beds of the Chattian and the Rupelian may be found about 9000 feet below this dome. It is probable that towards the Alpine margin the folding in the deeper beds is more accentuated than it appears in the Burdigalian. Observations at Oron in the Broye valley have shown that flat Burdigalian overlies steeply-folded Aquitanian. This indicates pre-Burdigalian folding. As a result of the work of the Petroleum Expert Commission the stratigraphy and tectonics of the west Swiss Molasse have been made very much clearer, but before undertaking exploratory drilling for oil the structural conditions at depth should be investigated by geophysical methods.

The Molasse of Canton Genf has been the most intensively investigated of all the prospective oil areas of Switzerland. Pitting and shallow drilling led to the discovery of several lenticular sand deposits in a Chattian complex about 900 feet thick. In the Peissy well a total

» CONTINUED ON PAGE 230

East Indies Production

At 80 Percent of Prewar Volume

AN OUTSTANDING example of successful postwar rehabilitation and development is that given by the East Indies, once the principal source of exportable crude oil in the Eastern Hemisphere, but whose oil fields and other petroleum installations have had to overcome systematic destruction by two warring factions.

Since the close of World War II the operating companies have succeeded in bringing the output from the entire region to more than 80 percent of the prewar output, and this has been done despite the fact that local political disturbances have continued through a large part of Indonesia since the end of the war, making a substantial part of the former producing area inaccessible to operators up to the present time. Some of the work in Java and Sumatra has had to be done over and over again in the face of destruction by insurgent local elements who have set fire to oil wells, broken pipe lines, and blown up refinery units. Even now almost the whole of Java is still denied to the Dutch, British and American operators with the exception of a few small fields producing in the aggregate about 1000 barrels daily.

The most outstanding increases have been possible in Southern Sumatra and Borneo, particularly the latter, where the British Malayan Petroleum Company, a member of the Shell group, has brought the Seria field of Brunei to a producing level four times as great as before the war. In the Palembang area of Southern Sumatra the Standard-Vacuum Petroleum Maatschappij has succeeded in bringing production from the fields it has been able to operate to a level slightly greater than prewar, most of the production coming from the Pendopo area.

The Shell Group has made good use of its opportunities to expand the Seria field since it was re-occupied by the Allied forces in the middle of 1945, although such was the extent of the damage at that time that nearly a year elapsed before the first shipment of crude was made. Since that time recovery has been steady and rapid.

The Seria field was discovered in 1929, after British Malayan Company geologists had completed a detailed study of the area along the coastline on the South China Sea, and for some distance back into the swamp and jungle which at this point closely borders the sea. At that time the Miri field, in Sarawak to the southwest, had been producing since 1911, and was yielding more than 3000 barrels daily. However, the Seria field was soon recognized as being of far greater importance than the Miri area. Although the producing formations were somewhat deeper they were much better developed than the broken sand lenses from which the Miri field produced, and wells were capable of sustained flowing life over longer periods.

Field Enlarged

By the beginning of the war the field had been enlarged to approximately 3200 acres, extending for a length of between five and six miles along the coast, and with a width of approximately one mile. It is thought that the producing area might extend for perhaps as much as a mile offshore, and plans are now under way for a drilling program of the offshore area. Some of the close-in acreage has been exploited for a number of years, wells having been drilled from jetties extending as far as 800 feet from the shoreline, and some wells have been reaching the offshore area through directional drilling.

Near the end of 1948 five rigs were operating in the Seria Field, and most of the current drilling is to the deeper horizon which is topped around 6000 feet. Other sands are found as shallow as 1600 feet, but the better sections are said to be the deeper ones. As much as 400 feet of producing section has been drilled in some of the deeper horizons, although zones 80 feet thick have been found in the upper pay. Sands are of Tertiary age and no difficult drilling problems have been encountered other than separation of occasional gas and water zones. Gravity of the oil varies from 19 to 33 degrees, some being asphalt base, but most of it paraffin base.

The amazing growth of output from the field since the close of the war has given rise, in the absence of detailed information on operations in the East Indies areas, to the belief that the Shell Group has discovered an exceptionally important new pay zone or perhaps a substantial extension to the former producing area. However, it has been made clear that the field is still developing and producing from the same formations originally discovered and exploited, and from more or less the same area as had been exploited before the war. Up to that time, through the first 10 or 12 years of the field's life, it had simply not been necessary to make a special effort to step up output from the North Borneo fields since sufficient production for requirements from the region was being obtained from the older areas of Java and Sumatra. The Seria field at the beginning of the war was producing about 16,000 barrels daily. Since it was one of the first areas recovered from the Japanese and therefore one of the first sources of oil from the Indies to be reestablished, its development has been much more rapid than it was before the war, once the repairs of wartime demolition had been effected. Currently it is producing at a rate of 63,000 barrels a day and is assuming an increasingly important position as it now makes the State of Brunei the largest crude producer in the British Commonwealth. Its importance to the British is enhanced by being located in a sterling area, and with most of the materials for reconstruction and development coming from sterling sources, an increasingly supply of sterling oil is now entering world markets, and very little drain on the supply of dollars is necessary.

Seria's importance is also based to some extent on its geographic location, since it is in a position to better supply the markets of the Far East and Oceania than are the larger crude sources of the Middle East or Venezuela.

At the time of the Japanese occupation the operators of the Borneo fields were prepared with a carefully planned program of denial operations. Through this early planning it was possible to begin systematic destruction of oil facilities at Seria and Miri on December

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8, 1941, in accordance with the preconceived plan. The results were very satisfactory at the time, although the period of Japanese occupancy was long enough that they were able to carry out a great amount of rehabilitation and to produce a considerable amount of oil during the four years they were in control. Operators of the field set up a figure of 10,799,000 barrels of crude as the amount produced by the Japanese. This figure does not include oil lost through fire, either from burning wells or oil in storage. Production by the enemy reached its peak during 1944, although by that time the fields on the eastern side of Borneo and elsewhere in the East Indies had been restricted through steady Allied bombing attacks and the submarine campaign against shipping. Actually the fields of British Borneo did not come under heavy attack until October, 1944.

With the landing of the Australian forces on Borneo in 1945 came another denial operation, this time on the part of the Japs, and when the Allied troops occupied the field in June of that year they found it most thoroughly wrecked. Buildings and other surface installations had been demolished by the retreating forces, and wells were fired. Within the first three months it was necessary to extinguish nearly 40 burning wells. Military personnel aided in this work under the direction of Shell Group experts. Such were the problems of cleaning up the debris and getting wells back on production that it was not until March of the following year that the first oil left the area by tanker.

During 1947, twenty-two new wells were drilled, and production at the end of the year had reached a rate of 49,500 barrels daily. Now there are 150 wells, of which 59 are flowing, with 84 wells producing on gas lift. During the year the operators moved in considerable new equipment and personnel in anticipation of an active offshore program.

Production from Seria as well as from Miri is carried by pipe line to the Sarawak Oilfields Limited refinery at Lutong, which is currently processing about 35,000 barrels a day, or more than one-half the oil produced at the two fields. Before the war the capacity of this plant stood at 20,000 barrels daily, or more than sufficient to care for the production from British Borneo. Since the close of the war the plant has been rebuilt, and new units have been installed to increase capacity. It is now thought that a completely new refinery will be built within the near future. A short time back it was thought that the new refinery would simply replace the existing facilities, but with increase in production from the area, both plants may be retained for the time being.

The Search for Oil in Switzerland

■ CONTINUED FROM PAGE 227

of 60 feet of oil-impregnated sandstone was established, the oil content of which was somewhat less than that of the oil-sand which was formerly exploited, indicating that the deposits at the edge of the basin have had their oil and gas content depleted by earlier deep erosion. The commercial working of this deposit is thus uneconomic. However, there is the possibility that deeper into the basin, south of the Rhone, the facies is more favorable for the formation of productive oil accumulations, but wells of 1500 to 2500 feet must be reckoned with.

There is no agreement between French and Swiss geologists on the origin of the Genf Molasse oil. Some say it occurs in place while others believe it originated at depth in Lower Stampian beds, or possibly came from the Trias. These differences of opinion give no ground for the abandonment of the oil search. Experience in Hungary, Austria, England and Holland has shown how much technical opinions can differ on the origin and possibilities of economic oil accumulations before the deposit is actually discovered.

On the origin of the Swiss asphalt deposits there is also no over-all agreement. The asphalt occurrences in the Cretaceous, Malm and Dogger are either supposed to come from Tertiary oil horizons or else they are related to hypothetical Mesozoic deposits. In addition, there is a theory that they are formed in place. Recent investigations of the asphalt deposits of the Val de Travers and Les Epoisats have given no final answer.

The recent prospecting in the sub-Alpine Molasse zone dealt principally with the gas occurrences in the Linth district and in the St. Gallen area of the Rhine Valley but resulted in no definite exploration of the formation and origin of the gas occurrences which are principally composed of methane. The location of the strongest gas flows at the overthrust of the Flysch on the Molasse at Altstatten shows that the gas comes from Molasse or deeper beds. Gas shows in similar geological situations are found in the Vorarlberg, in the Waggital, west of the Linth plain, as well as at the Lauerzer See in Central Switzerland. The question of the economic production of the gas which in places also comes from the Rhine alluvium remains unsolved so long as exploratory wells are not put down through the 600 to 1000 feet of recent alluvium.

Gas shows have been found in the Upper Zurichsee, and seem to be almost exactly in the axial area of steep anticlines in the folded sub-Alpine Molasse. They may be a continuation of the gas occurrences found in the Ricken tunnels which greatly hindered its construction.

A mine in the Flysch at Schwanden in Canton Glarus encountered strong gas flows of unknown source. Perhaps it came from the Molasse which reaches far into the Alps beneath the Flysch cover.

On the grounds of the above data, most experts are of the view that the problem of the occurrence of economic oil and gas accumulation should be solved by more exploratory drilling. If the reasons for the failure of former attempts are considered it will be seen that most tests were either geologically unfavorable or spoiled by lack of technical skill. The best locations have not been drilled.

On the basis of the results of the exploration of the Petroleum Expert Commission, an International Oil Trust about a year ago considered taking up the Swiss oil concessions and carrying out a large-scale exploration program. Nothing has come of this intention. Favorable results in the oil search in neighboring Bavaria and Wurtenburg would certainly affect the search in Switzerland.

The latest development reported is that bituminous oil shale deposits which occur in the Swiss Jura, more particularly between Courtemautruy and Asuel, and which contain an average oil content of 4½ percent, are to be utilized for the manufacture of a special building material with the cooperation of Swedish interests which have developed a method for making satisfactory building material from Swedish oil shale residues. The erection of a suitable plant would improve the economy of the Swiss Jura area, which at present depends excessively on the watch-making industry.

Venezuelan Steel Surplus Is Result of Reduced Operations

An excess of steel exists for the Venezuelan oil industry, reversing what appeared to be a sharp steel shortage of last year, according to Eugene Holman, president of the Standard Oil Company (N. J.), who has recently returned from a visit to Venezuela. Holman expressed it "Steel is now running out of our ears down there." The present steel surplus, he said, reflects the reduced drilling operations which are general throughout Venezuela.

Holman predicted that the 1949 Venezuelan crude oil output would be about at the level of 1947. He said Jersey Standard's affiliate, Creole Petroleum, had averaged 635,000 barrels a day in Venezuela in 1948 with a peak of 652,000 daily in September. The 1947 average was 589,000 barrels daily.

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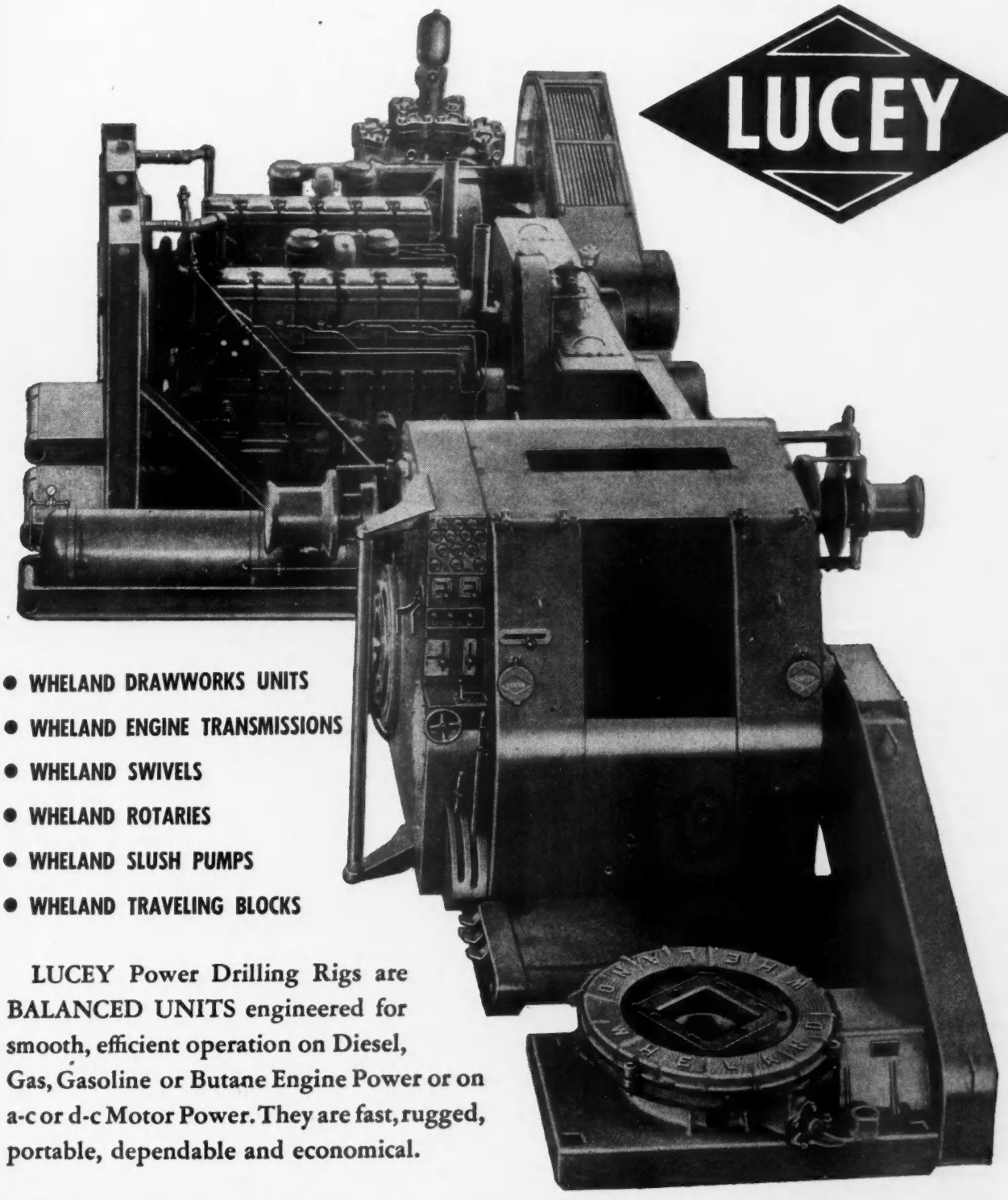

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Syria Becomes *Hot Spot* Of Middle East Oil

SITUATED IN the midst of the rich oil fields in the basin between the Persian Gulf and the Eastern Mediterranian, Syria has assumed a key role in the race between U. S. and British interests in the development of the area. Recent activities in the region indicate that Syria inclines to favor American operators in production, but the British in the matter of pipe lines. The future of Middle East oil depends a great deal on Syria's actions, and American and British cooperation.

SYRIA has become the "hot spot" of Middle East oil, both in a political and a developmental sense, and many industry observers believe that to a large extent the course of American petroleum investments east of Suez depends on forthcoming happenings in Damascus, the world's oldest capital.

Politically, Syria is seen as holding the key to the outcome of the intensified race between the American and the British petroleum industries to develop the oil-lush basins between the Persian Gulf and the Eastern Mediterranean. Exclusive British production centers in southwest Iran; exclusive American development in Saudi Arabia; and American and British forces are joined through the Iraq Petroleum Company partnership in Iraq.

The Syrian government that was overthrown by the recent coup of the army under command of Gen. Husni Zayim, has favored the granting of pipe line transit rights and development concessions to Americans, but Zayim himself says that his provisional government will delay action on oil matters. Further, the stability of his regime is uncertain, and contracts signed by him might be voided in the future.

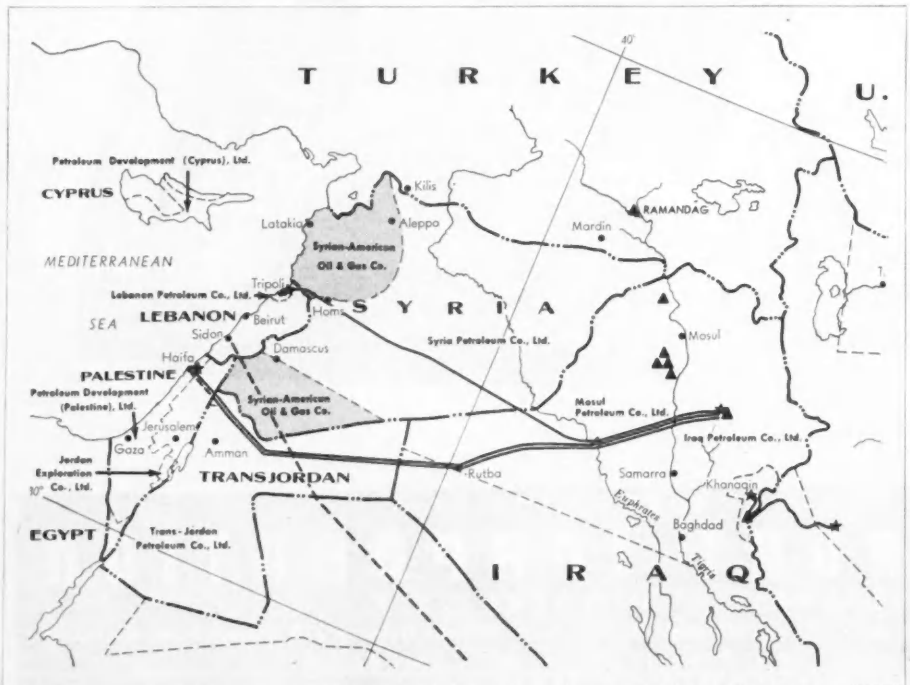
Syria apparently is trying to straddle both American and British interests to improve its own oil position in the Middle East. To further its own production program, Damascus appears to be seeking the aid of Americans; but to strengthen its pipe line program, it is favoring the British. When IPC (regarded politically as British despite its 23.75 percent American participation through Standard Oil Company (N. J.) and Socony-Vacuum Oil Company) surrendered last February nearly one-third of its concession area in Syria, Damascus turned to a Syrian-born American, James W. MenHall, of Benton, Ill., to take up the relinquished acreage. The MenHall concession, about 22,000 square miles, would be developed under a $100 million program, half of the funds for which would be subscribed in the U. S. and half in Syria.

Yet Syria obviously is keeping the door open. While Damascus reportedly rejected concession deals with British interests in favor of the American program, the MenHall arrangement has not yet been ratified by the Syrian parliament, or even officially announced by the Syrian government. As one industry economist put it: "If Syria learns that MenHall can't swing the deal in the U. S., she can turn back to our British friends."

Also, Syria is using the projected MenHall deal to spur the IPC to still greater efforts for the discovery of oil in Syria. Syria wants oil badly and to speed its own production has eliminated down payment and yearly rental, from the MenHall deal, but stipulates that MenHall must have operations under way 90 days after ratification of his contract.

Meanwhile, IPC has abandoned its first two postwar tests in Syria but has spudded two more wildcats and is spotting a third location. The abandoned tests, both dry, are Baflioum, northwest of Aleppo, which was abandoned in September at 8666 feet, and Dola, in the Palmyra Basin, south and east of Aleppo, which went to 6163 feet. Both these tests are in the Western Syrian zone relinquished by IPC and included in the new MenHall concession.

IPC is drilling farther east in Syria at Abba, in the central region of the



Northwestern portion of Middle East region. Shaded area is concerned in the recent agreement with Syrian-American Oil & Gas Company.

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country, just south of the Euphrates River, where the crew spudded in the first of last October; and at Gouna, northwest of Abba, spudded January 5, 1949, and where drilling was slowed at 2800 feet because of a fishing job.

However, IPC's most promising current work is in new regions of Iraq, particularly around the Basra area. Al-Zudair, a rank wildcat, was drilling west of Basra, and a discovery has been made at Mar Umr, northwest of Basra, where the wildcat tested 2500 barrels a day at 8317 feet. A third wildcat is drilling at Ratawi, west of Basra.

IPC thus is converging its drilling operations toward the famous Kirkuk structure, and spreading north and south from there. The new Syrian tests are aiming toward the northeast corner of Syria, at the junction of Turkey and Iraq, a region almost due north of Kirkuk. This line runs through the recently opened Ain Zalah field, and many geologists are wondering if there may be a fairly continuous structure bearing southeast by northwest far beyond the presently estimated 120-mile length of the Kirkuk structure. To the south, the new Basra area would fall on the same line, but at too remote a distance to be of the same structure.

Qatar is also receiving intensive attention from IPC after the discovery of four producing wells there. Qatar 1 and 2 were drilled before World War II but were plugged during the war. No. 3 was dry, but Nos. 4, 5, 7 and 8 were producers. No. 6 was a mechanical failure. The four shut-in producers are estimated to have a rate of 6000 barrels a day, and will be opened with completion of the trans-Qatar pipe line. This line will be in operation by September and by connecting the fields with tidewater, Qatar will become an exporting area for crude. The pipe line will be 55 miles long, of 14½-inch diameter pipe, with a capacity of 40,000 barrels daily. It will have one pump station.

In order to press operations in Syria and Iraq, IPC has virtually shelved all plans for test drilling in Transjordan where it holds a blanket concession, and plans no further work in Lebanon or in Palestine. In the former country, IPC drilled a 10,000-foot dry hole near Tripoli, and in Palestine was drilling at Gaza and Kurnub when operations were suspended because of the Jewish-Arab war.

IPC is speeding work on its new 16-inch pipe line paralleling the existing 12-inch system from Kirkuk with branch legs to Haifa and Tripoli. The north leg of the new line, from Kirkuk to Tripoli, will be completed by October with British and French pipe, while the south leg, to Haifa, is already in the ditch except for a 50-mile stretch across Palestine. IPC officials report they can complete the south leg six weeks after settlement of political difficulties. In addition, IPC plans a new 30-inch line direct from the Kirkuk field to the Syrian coast, probably terminating at Tartous, although the terminal location has not yet been determined. Orders for this pipe have been scheduled in the U. S., and delivery will begin in late 1951.

IPC Advantage

Syria, which has refused yet to ratify conventions with Trans-Arabian Pipe Line (Tapline), for transit of the 1100-mile line from the Saudi Arabian fields to Sidon, Lebanon, has an operating contract with IPC under which that company's new 16-inch lines are being laid. Unless the Syrian parliament ratifies the Tapline convention before Autumn, IPC alone will have the trans-Syrian permit, and hence will be the only company able to pipe crude from the Persian Gulf area to the Mediterranean. Such a situation would give IPC a heavy advantage over Tapline and its parent company, Arabian American Oil (Aramco) in the race to develop Middle East resources.

Waiting Syrian approval, Tapline plans to go ahead laying its desert line across Saudi Arabia under the assumption it can put down more than 700 miles of the line and still choose an alternative end route in case the line is barred from Syria. Two alternative end-routes would be possible: one through Israel to terminate at Sidon, as now scheduled; the other across the Gulf of Aqaba, terminating on the Sinai Peninsula in Egypt. The latter route would keep the line wholly within Saudi Arabian territory until it crossed the Gulf of Aqaba.

Meanwhile, Middle East Pipe Lines, Ltd., a projected British line with American participaton, from Iran to the Mediterranean, hinges its project on the completion of Tapline, both for pipe schedule and for the kind of political convention under which it may operate.

Thus Syria has assumed a key role in the whole Middle East oil picture: it plans to force a rapid development program of its own petroleum resources; it holds the immediate fate at least of the transit of American oil to the Mediterranean; and it is ready to give the nod to either British or American interests, depending where it can make the best deal for its own revenue purposes.

Recent Completions Indicate Greater German Development

German oil men hope for a still greater expansion of the Emsland output with continued development of the Georgsdorf field, southeast of Emlichheim. Two wells recently completed have indicated that the limits of the producing area may extend much farther on both the northern and southern ends.

One of these recent wells was on the extreme northwest side of the field, north of one of the narrow fault zones extending across the field in an east-west direction. It found oil pay at a depth of 2140 feet which resulted in a production of 350 barrels of crude daily with considerable gas. Another test on the western side of the field and almost one-half mile from previous production, found the Bentheim sandstone producing horizon just above 3000 feet, with good oil saturation and no traces of salt water. This would bring a considerable new area into exploitation.

In this field the oil sand has a thickness of from 100 to 125 feet, and the normal drilling pattern has called for wells on blocks of approximately 20 acres each. Currently, the reservoir studies show no decline in pressures at the present producing rates, and it is thought that operators would be justified in adopting a narrower spacing. It it estimated that on closer pattern there should be at least 400 locations which might be drilled. Estimated proved area of the field before the new extension wells were found was 1600 acres. Although its present output of 1800 barrels a day is being handled through two 4-inch lines leading from central gathering stations to a railroad loading rack at Veldhausen, new transportation facilities may have to be provided if any appreciable advance in daily production is achieved.

The field was discovered in 1944, and is operated by the Preussag firm, although the acreage itself is owned by a combination of companies including C. Deilmann, Gewerkschaft Elwerath, Preussag and Wintershall A. G. It has 47 producing wells, most of which are flowing, and although its daily production is not outstanding by present world standards, it is still sufficient to hold third place among German fields.

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Austrian Development Program Begun by Russians

DISCOVERY of oil at Matzen, Austria, 20 miles northeast of Vienna, has prompted the Russian administrators of that country to launch a development program which they predict will increase Austria's yearly petroleum output by 25 percent.

The discovery well at Matzen is on the line of the older Zistersdorf field and the Russians already claim that the new area will be the most productive in Austria with completion of "several score of wells" to be drilled on the Matzen structure. Details of the discovery have not been fully revealed, but the Russians have disclosed that oil was struck at a depth of 1800 feet, and that the Matzen well produced 1500 barrels a day on a short test. The well was then cut back to about 600 barrels a day, its present flowing rate.

The discovery was made just prior to the opening in April of the four-nation conference at London to negotiate a settlement of all the issues involved in the Austrial oil situation. The Western powers hope to embody a petroleum accord in the peace treaty to be negotiated with Austria, and to alter the current 60 percent claim by Russia on Austrian oil production. The Soviet delegate to the London conference, Georgi N. Zarubin, refused to disclose exact Austrian production figures from 1947 to date, despite the argument of U. S. delegate Samuel Reber that "no 60 percent claim can be established by the Soviet Union unless we know total Austrian output."

Zarubin replied that unless Soviet claims were met "in principle and without the bother of going into details," the Russians would prevent the Western nations from inspecting other properties to be distributed to the occupying powers in lieu of German assets. The U. S. delegate answered that his country would make no commitment for allocations unless Russia specified what oil bearing lands it is claiming, and revealed some production figures.

Reber announced that the best available estimates of Austrian oil production for 1947 were in the order of 927,000 tons (6,800,000 barrels). The 1948 output is believed to be about the same level as 1947. The bulk of this the Russians have been exporting to Czechoslovakia and Germany, and Austria claims that it has lost an income of $35 million to $50 million yearly by the Soviet confiscation, and has been forced to rely on Marshall Plan imports for her own requirements.

The Russians gave early indication they would demand all the oil-producing properties in Austria except those belonging to Richard K. Van Sickle, a Canadian operator, and those of Rohoelgewinnungsgesellschaft, jointly owned by the Shell Group and Vacuum Oil Company, the latter in turn being an affiliate of Socony-Vacuum Oil Company. These properties account for about 40 percent of Austrian production and are the only ones where the issue of former German assets is not involved.

Not New Discovery

The Matzen discovery raises an important new question as to who holds exploration rights in the new area. Under a 1938 law, such rights were given to a German company and cover the Matzen region. The U. S. has indicated that it takes the position that these rights should revert to Rohoel, from which they were taken.

The Matzen area itself is not an altogether new discovery in the strictest sense of the term, the structure having been outlined for more than ten years. The anticline or dome was defined by the Rohoel company in 1937 and 1938 through geophysical work and core drilling, but the war prevented testing it. Meantime, the Soviets have been prospecting the structure. A well drilled in 1947 indicated the existence of oil, but was never brought into production because of mechanical difficulties and was finally abandoned. Another well was started which in May, 1948, found gas under high pressure, but the Soviets were unable to cope with the blowout which occurred and it ran wild, making a large volume of gas until it formed a crater deep enough to bury the derrick.

The oil discovery reported above is the third test on the structure, started during the latter part of last year, and is situated in the vicinity of the two other tests. No information has been given as to the possible thickness of the producing horizon, but any new source of oil is important to Austria.

Information reaching the U. S. indicates that the Matzen strike is the only successful exploratory venture of five wildcats drilled by the Russians in the eastern zone of the country. Matzen is in the central part of the Vienna Basin about 20 miles northeast of Vienna. While information on the first two tests on the structure would indicate the existence of an oil field, no information has been available regarding the discovery well other than that from Soviet sources.

For the first time since the close of the war, some exploratory work is being done in Upper Austria, where the Rohel organization is starting geological and geophysical work in the area of the Alpine forelands east of Salzburg. As far as is known, no concession has been granted to cover the particular area under examination, but the work is being done under contract with the Austrian Geological Institute.

The Muhlberg field has been the one area responsible for slowing the decline in Austrian production. Discovered in 1942, it has received most of its development since the cessation of active hostilities in World War II. During 1947 it produced slightly more than 1½ million barrels of oil, which was almost double the production in 1946. At the beginning of 1948 there were 18 productive wells at Muhlberg, and six new producers were drilled during the year. Although it is reported that at least 20 locations remain to be drilled within the limits of the producing area, some concern for the future prospects of the field is felt due to the practice of flowing the wells at rates too near their ultimate potential in an effort to offset the decline of other fields and hold the entire output from Austria at as near a constant level as possible.

Most of the other Austrian fields have been thoroughly drilled up, with very few drillable locations remaining other than through attempts to extend the producing limits. It is also reported that up to this year most attempts at heavy exploitation drilling have been

held back by the lack of drilling equipment and casing on the part of the non-Soviet operators. The Russians, however, imported five modern drilling rigs during the year and observers report that they seem to be largely of American manufacture, probably having been received by Russia during the latter part of the war under lend-lease. Casing has been in short supply for all interests there, but it is now reported that during the latter part of 1948 additional casing was being brought in from Czechoslovakia.

Deep Drilling Commenced In Papua-New Guinea Area

Two of the deep drilling operations of the Papuan exploratory campaign have now been actually started, while the third is setting up the rig and should be drilling before long. The operations are by Australasian Petroleum Company, and it is understood that current plans call for moving in even more equipment to be used in wildcatting the extensive block of exploratory grants. The area included in these grants amounts to 9944 square miles in Papua and an additional 8919 square miles in the Mandated Territory of New Guinea.

The first of the new series spudded is at Oroi, on the Vialala River about 50 miles northwest of Port Moresby, and it is drilling below 1694 feet after having been delayed for some time in conditioning the hole following trouble with fissured zones between 430 and 1087 feet.

At Upoia, another 50 to 75 miles up the river, another wildcat was spudded during January and was drilling below the 13⅜-inch casing set at 416 feet at the time of latest report.

The Hororo well, five miles from Upoia, is still setting up rig and should be ready to spud within a short time.

Meanwhile drilling sites have been selected for a well at Malalaua and at Wana, in the vicinity of Port Romilly. Roads are being built across swampy areas so that access may be provided to the Malalau a location when additional drilling equipment arrives.

Steps Are Taken to Form French Pipe Line Company

The French government proposes to set up a company to build a pipe line from Le Havre to Paris, and has introduced a bill to create such a company into the Assembly. As now visualized, the company would be known at the Société des Transports Petroliers par Pipe-Line, and a proportion of the capital amounting to at least 51 percent, but no more than 55 percent, is to be supplied by the Government. The remainder is to be supplied by private investors.

Such a line has been discussed for some time, but this is the first action taken toward getting it under way. It would be designed to carry refined products, either gasoline or gas-oil to the capital at a rate of 10.5 million barrels a year, and would result in cheaper product cost to consumers through a reduction in transportation deficits estimated at 50 percent.

Some fuel relief has been extended to more distant areas in the southern part of France by the expansion of the pipe line system carrying gas from the Saint Marcet field. The trunk system now delivers gas as far as Bordeaux, a distance of more than 200 miles from the producing area.

Meanwhile France is pushing its search for oil supplies both in the country itself and in its colonies. In all there are 42 drilling rigs operating, of which 24 are heavy-duty rigs capable of testing any necessary formations, and activity during 1948 resulted in an increase of nearly 75 percent in the amount of footage drilled. The search has been disappointing, since no really commercial oil was found. Shows of considerable promise have been found at at least two locations in Southern France, but in neither case has the first development proved to be of commercial scope.

New Construction Features Oil Operations in Spain

Spain, which now has a refining capacity of roughly 10,000 barrels a day, is planning new construction projects designed to increase its capacity to three times that much. Projects now under way consist of a new plant at Cartagena and of additions to the existing refinery at Santa Cruz. It is hoped that capacity will be brought to 20,000 barrels a day by the end of this year, with the remainder of the construction to be completed during 1950.

There has been a recent report that oil has been found in the Province of Cadiz. This is in an area where the Empresa Adaro has been drilling to shallow depths with a light rig near the town of Chiclano de la Frontera, south of Cadiz in the southwestern part of Spain. The current reports are to the effect that some oil has been found. Previously the company had found some slight showings of gas in this area at a depth of 500 feet.

Wildcat drilling is also being carried on by the combine of the Socony-Vacuum Oil Company and private Spanish interests in the north central part of the country, following drilling of a deep dry hole on the Oliana structure last year. At the same time a Spanish government company is carrying on work in the area north of Burgos where showings had previously been found.

Promising Gas Field Opened West of Schoonebeek Area

The Nederlandsche Aardolie Maatschappij has discovered what appears to be a gas field of considerable promise west of the Schoonebeek oil field. However, the gas-bearing formation was found at a considerable depth, and consequently early evaluation of the area will have to await the arrival of additional heavy drilling equipment.

The new area is on the same east-west trending uplift on which the Schoonebeek field is located, and on the basis of known information is at the highest point on the uplift. The wildcat that proved the existence of gas here was two miles due west of the town of Coevorden and was drilled to total depth of 9137 feet, where it found the gas in fractured Permian limestone. A string of 6⅝-inch casing was cemented at 9057 feet for a test in open hole which showed a large gas potential.

The same operators have been active in the development of the Schoonebeek field, bringing its producing potential up to 11,400 barrels daily by the close of 1948. Early this year they reduced operations in the field so that the equipment could be used for exploratory drilling elsewhere in the Netherlands. With increased availability of drilling equipment and materials, it was possible to complete 41 new wells in the field during the past year and bring total production of 24.8-gravity oil during the year to 3,444,000 barrels.

The Nederlandsche Aardolie Maatschappij is owned jointly by the Shell Group and Standard Oil Company (N. J.) with Shell handling operations.

Middle East Leads as Source Of United Kingdom Oil Supply

The Middle East now supplies the United Kingdom more of its petroleum imports than does the U. S., it has been disclosed by the Office of International Trade of the Commerce Department. In 1948 the Middle East furnished Britain and its posessions 35.4 percent of its petroleum imports as compared with 23.7 percent the year previous, while imports from the U. S. were 11.8 percent in 1948 as against 25.7 percent in 1947.

The changing trend is shown in the following table:

Source of United Kingdom Petroleum Imports

(In thousands of barrels)

	1948		1947	
SOURCE	Quantity	Percent	Quantity	Percent
West. Hemis. (Total)	77,932	58.4	74,755	75.7
Neth. West Indies	52,333	39.2	36,038	25.7
U. S.	15,745	11.8	25,408	25.7
Brit. West Indies	5,889	4.4	6,970	7.1
Venezuela	2,820	2.1	5,676	5.7
Middle East (Total)	47,263	35.4	23,465	23.7

Oil Production Will Expand With Increased Competition

Competition among the oil-producing areas of the world is being restored on the basis of availability and price, Eugene Holman, president of the Standard Oil Company (N.J.), told a recent press conference at Caracas, Venezuela. He analyzed the reason for the current decline in Venezuela's crude output in these words:

"I feel that in the long view we can expect the demand for petroleum to increase. A situation such as we have today, in which we find we can produce more petroleum than the world can currently buy, does not mean that petroleum has lost any of its usefulness. The fact is simply that the world petroleum-producing areas, Venezuela included, have made such strenuous efforts to increase production to meet six years of war demand and four years of postwar inflationary demand, that now we can produce more petroleum than the consumer can use.

"No one can say when exactly the demand will catch up with our capacity to produce, but I am sure that in the long history of the petroleum industry, the present reduction of petroleum production will look inconsequential."

The best means of guaranteeing a production expansion, Holman said, "is to keep the price competitive by being efficient and avoiding waste."

As to Venezuela's future place in oil production, he said, "Venezuela has enjoyed an unusual advantage for several years as a supplier of crude petroleum to foreign markets. It could even be said that Venezuela for a time had a monopoly in the sense that only Venezuela could be counted on for high-volume production of petroleum needed outside the U. S. This was a natural development of considerable benefit to Venezuela, I believe, in terms of increased income from petroleum. Its potential harm lies in the possibility that loss of an unusual advantage may cause some to assume that unfriendly or malicious efforts have been made to take the advantage away from Venezuela. I don't know of any such unfriendly or malicious effort. I know, however, that other petroleum-producing areas are trying to compete with Venezuelan petroleum in the world market. The fact that we must acknowledge is that competition among producing areas of the world is returning on the basis of availability and price.

"Nothing, of course, can deprive Venezuela of its geographical advantage in supplying petroleum to the Western Hemisphere, which is Venezuela's natural market. This is a growing market and one which will take Venezuelan oil if it can be delivered at a competitive price.

"Creole Petroleum Corporation obviously has faith that this can be done. In 1948 it re-invested $165 million in Venezuela and in 1949 will re-invest a like sum. Nearly all of this re-investment comes out of profits."

HOUSTON NOMADS VISITORS—The Houston Chapter of Nomads at its April meeting heard a discussion of the petroleum industry in Mexico. Foreign visitors attending were, left to right, J. R. Wilburn, Petroleos Mexicanos; F. M. Crawford, United British Oilfields of Trinidad; Jorge Gutierrez and Alfonso Besquin of Implementos Petroleos, Mexico; Oscar B. Irizarry who led the discussion, and J. B. Harder, manufacturers' representative in Maracaibo.

Exploration Activities Slight As Cuban Production Declines

Activity in Cuba has declined somewhat during the past year, with a small amount of development drilling for the Serpentine production found in the Jarahueca, Motembo and Bacuranao fields. Such wells as found production were insufficient to arrest the decline, and total production for 1948 amounted to 112,000 barrels from Jarahueca and Motembo, compared to a total of 248,500 barrels during 1947. Production from Bacuranao field, Habana Province, has become insignificant in recent years, amounting to an estimated 700 barrels for the past year. Cumulative total production for Cuba is estimated at 712,000 barrels, a small return for the exploratory work which has taken place from time to time.

Wildcats were drilled in 1947 by the Shell Group and by subsidiaries of the Standard Oil Company (N. J.), one being carried below 10,000 feet, but no exploratory drilling has taken place in 1948. The Compañía Petrolera Eureka, a Gulf Oil Corporation subsidiary, has been carrying on some exploratory work during 1948, consisting largely of basic geological work, but also including surface geophysical work in addition to some surveying by airborne Magnetometer.

Blaze at Palembang Refinery Causes Temporary Shutdown

An explosion and fire at Standard-Vacuum Oil Company's Palembang refinery in Sumatra resulted in injury to 12 employes and caused a temporary shutdown of part of the plant.

Starting at 6:55 in the morning with a short circuit in one of the refinery generator substations, power failure caused oil vapors to accumulate rapidly in a receiving house near the crude stills. Almost immediately afterward, and before compressors feeding crude oil to the stills could be shut down, a terrific explosion occurred in the receiving house which damaged equipment and office buildings some distance away and set fire to nearby processing tanks. An hour later the roof of one tank was blown off, but the blaze was kept away from other tanks and equipment until finally brought under control 24 hours later.

Standard-Vacuum officials at Palembang estimated that the output of the refinery would be reduced to about half its normal rate for a period of two weeks.

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Venezuela's Tucupido Field Yields 9000 Barrels Daily

About 9000 barrels of 39.6-gravity oil are now being marketed daily from the new Tucupido field in Eastern Venezuela, in which Pancoastal Oil Company, C. A., and Venezuelan Atlantic Refining Company each has a 50 percent interest.

Tucupido comprises 37,500 of an aggregate of 320,000 acres under concession in Venezuela to the two companies and has been the scene of intensive drilling operations only since last April 29, when Atlantic exercised option to acquire its one-half interest. Sixteen producing wells have been completed, of which 13 have tested a total capacity of 9900 barrels daily with an average of two wells closed in.

Last April only two wells had been completed on the Tucupido concession, located in the state of Guarico, near the middle of the Eastern Venezuelan Basin. These two were completed in the Betty sand at about 5500 feet each. Two other wells tested dry in this sand and three were drilling at that time.

First production tests on the two flowing wells indicated a total output of 1200 barrels daily. In addition, one gas well had been completed, with estimated potential on open flow of about 20 million cubic feet per day at 2450 feet depth. A fourth rig was then moved into the field and by the end of August six oil wells and one more gas well had been completed. Six 10,000-barrel storage tanks had been erected and as each tank was opened, available wells went on production and underwent testing.

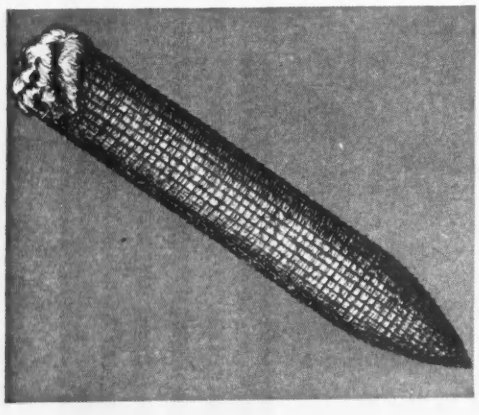
On August 30, the first oil was put through the Atlantic eight-inch line which had been laid from the field to The Texas Company's main line from Las Mercedes field to Puerto La Cruz. On September 1 the first field test on all wells produced a total of 4390 barrels of oil per day. On October 1, eight wells had been completed with a daily productive capacity of 5884 barrels. On October 20, a total of ten wells had been completed and flowed 8600 barrels per day, and on October 29, two more, making a total of 12 wells, had been completed and flowed on 24-hour gauge a total of 9200 barrels. One of the last completions was Tucupido 23, a stepout three-fourths mile east, which was tested for its first 24 hours through a three-eighths-inch choke at 1000 barrels daily.

By December 13, the field had one dry hole, two gas wells and 16 producers, of which 13 had been tested and were showing 9900 barrels a day. Of this, 9000 barrels were being sent to market, with an average of two wells closed in.

Pancoastal's interest in Tucupido production amounts to about 40 percent, and Pancoastal receives $2.765 per barrel in the field from Atlantic.

Two dry holes and four producing wells have been completed in the Pelayo concession, consisting of 12,000 acres and located 12 miles east of Gulf's Leona field in the Oficina district. The two producers have an indicated daily capacity of 1250 barrels. Atlantic is now laying a pipe line from this field to the Leona field, which is virtually completed.

In October the first producing well was completed on the Socororo concession, to the west of the Oficina district. This well tested 125 barrels a day from a sand encountered at 4000 feet. A few years ago Socororo 1 was drilled to this sand, pipe set, and the well tested. Due to mechanical troubles the well sanded up and was not brought back into production.



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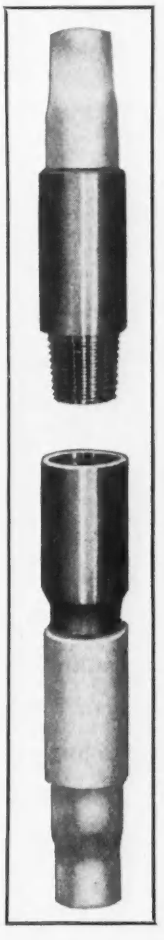

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Gulf Tubing Tool Joint Specifications

PB (illustrated) makes up on tubing coupling. DB converts tubing to light drill pipe; has female tubing thread each end.

Nominal Size	*TYPE CONNECTION		DIAMETERS		LENGTHS			Net Weight Assm'ld. Pounds	Taper Per Foot	Threads Per Inch	Length Thread Section
	Pin Down Box Up	Double Box	O.D.	I.D.	Pin	Box	Assm'ld.				
1¼"	PB	DB	2.20"	1.38"	6"	6"	10"	6.75	1½"	5	2"
1½"	PB	DB	2.5"	1.610"	7"	7"	12"	9	1½"	5	2⅛"
2"	PB	DB	3.06"	1.99"	8"	8"	13½"	14	1½"	4	2 7/16"
2½"	PB	DB	3.66"	2.44"	8½"	8½"	14½"	20	1½"	4	2 7/16"
3"	PB	DB	4.5"	2.992"	10½"	12"	19¾"	49	1½"	4	2¾"
3½"	PB	DB	5.0"	3.470"	10¾"	12¼"	20¼"	56	1½"	4	2¾"
4"	PB	DB	5.56"	3.958"	11"	12¾"	20¾"	60	1½"	4	3"

*8 or 10 thread connections optional. * External upset or plain end type optional.

Gulf Tool Company, P. O. Box 707, Houston, Texas

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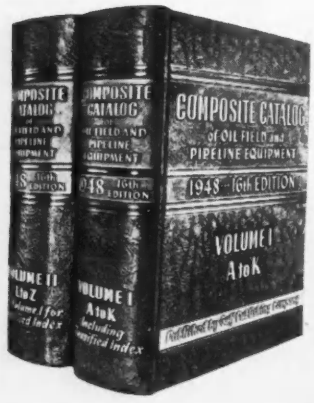

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COMPOSITE CATALOG

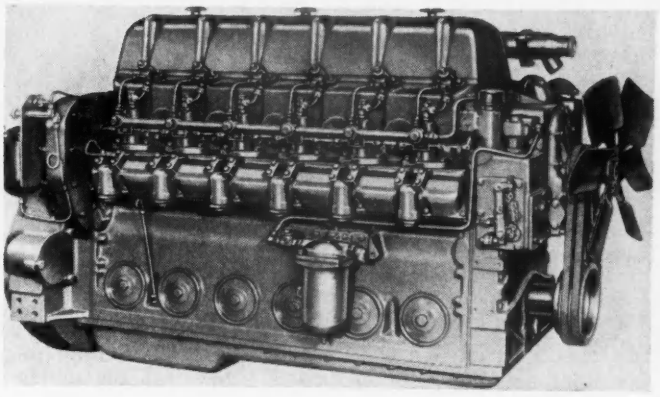
Published by WORLD OIL

NEW AND IMPROVED Equipment SUPPLEMENTING COMPOSITE CATALOG

New and improved equipment of manufacturers who describe their products or services in the current Composite Catalog

130—Diesel Engines

This item supplements The Harnischfeger Corporation data as shown on page 1706 of Composite Catalog.



A diesel power unit, operating on the two-cycle principle, combines the advantages of medium and high crankshaft speeds, satisfactory piston speeds, and an over-all lighter weight unit.

All engine parts are interchangeable from one model to another, with the exception of such parts as the crankshaft, camshaft, crankcase, etc., which are different due to the added number of cylinders.

P & H diesel engines have a bore of 4½ inches and a stroke of 5½ inches, with a displacement of 87½ cubic inches per cylinder. All pins and journals are drilled for continuous pressure lubrication. The camshaft is a heat treated alloy steel forging. The large diameter camshaft bearings are also pressure lubricated. Shown is the six-cylinder model.

For additional information write The Harnischfeger Corporation, Diesel Engine division, Port Washington, Wis., *referring to* WORLD OIL *item* 130.

131—Fluid Sampling Device

This item supplements McCullough Tool Company data as shown on pages 2557-2584 of Composite Catalog.

Three consecutive tests have been made in three different zones in a well, and samples have been procured from each zone without removing the tester from the well, by means of a new fluid sampling device.

The three zones, at 2800, 3400 and 3800 feet, had previously been gun perforated. The tester was run in on a string of drill pipe, to a point immediately above the bottom holes. A sinker bar, containing an electric connection and a sampling chamber, was lowered through the operating string on a regular conductor cable and a test was taken.

A sample was recovered by first pulling on the conductor cable, to shear a set of shear pins, which allowed the telescoping sampling chamber to open and admit a quantity of fluid. Then, upon continued upward pulling of the line, the latch that normally holds the sampling chamber down was forced open, allowing the sampling chamber to be pulled from the hole.

The tester was then moved up the hole, where similar tests were made and samples were taken at 3400 and 2800 feet.

For additional information write McCullough Tool Company, 5820 South Alameda Street, Los Angeles 11, *referring to* WORLD OIL *item* 131.

132—Pumping Unit

This item supplements Pattin Brothers division of Acme Fishing Tool Company data as shown on pages 113-136 of Composite Catalog.

Of comparatively light weight, this single well power unit meets pumping requirements in depths up to 2000 feet. Moderate speed, enclosed engine develops seven horsepower at 600 revolutions per minute adjustment, and operates on gas, gasoline or kerosine.

Six 100-pound weights are furnished with each unit for adequate counter-balancing. The polish rod connects to the steel walking beam with a five-eighths-inch wire line which can be replaced in the field. The pumping unit has an 18½-inch stroke.

Mounted on channel steel frame, the complete assembly is ready for bolting to foundation. It has pitmans of heavy angles, double bolted to beam, and manganese bronze bearings on ends.

For additional information, write Pattin Brothers division of Acme Fishing Tool Company, P. O. Drawer 860, Parkersburg, W. Va., *referring to* WORLD OIL *item* 132.

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REFLEX and TRANSPARENT
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Drop Forged Steel
Liquid Level Gage
Empty Space Shows White
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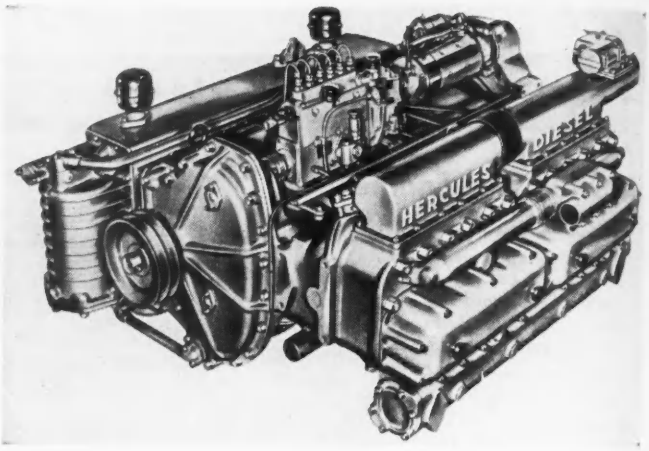
NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

133—Diesel Engines

This item supplements Hercules Motors Corporation data as shown on page 1719 of Composite Catalog.



The flat Model DFXHF diesel engine lends itself for tandem or independent operation for drawworks, drilling and mud pump, thus bringing all three of these units together on a compact portable trailer rig. To provide the necessary horsepower to handle all three operations, several flat engines can be mounted beneath the trailer bed, in order to make room for the mud pump which usually requires a separate trailer and its own power unit. Duplication of power and an additional trailer are eliminated. The horizontal-type engine is a six cylinder unit with a 5¾-inch bore and six-inch stroke. It has 935 cubic inch piston displacement and develops 260 horsepower at 2100 revolutions per minute. Over-all height is approximately 28 inches, length 61½ inches and width 48 5/16 inches.

Model DIX4 is a four-cylinder diesel built in two bore sizes, 3¼- and 3⅝-inch. Model DIX6D is a small six-cylinder engine capable of operating at speeds up to 3000 revolutions per minute. Each of these models has cylinder blocks of one piece with crankcase integral. The connecting rods are long and the big end bearing is split on an angle which allows maximum diameter crank journal which does not interfere with removing the connecting rod through the cylinder bore for maintenance. Detachable bellhousing is provided so that the correct size bellhousing can be mounted in accordance with the application.

The DNX-V8 is a 45° "V" engine. Over-all length from front of the fan blade to rear of the bellhousing is 56½ inches. It is of solid injection, compression ignition, four-stroke cycle type.

For additional information write Hercules Motors Corporation, Market and East 11th Streets, Canton 2, O., *referring to* WORLD OIL *item* 133.

134—Corrosion Preventive

This item supplements Tretolite Company data as shown on page 4132 of Composite Catalog.

A convenient inhibitor for gas and gas-condensate wells in which the tubing is packed or mudded-off, "Kontol 118 Stick" corrosion preventive can be used where the addition of liquid inhibitors down the casing annulus would be of no purpose.

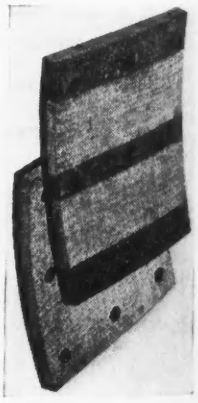
A cylinder 1½ inches in diameter by 18 inches long, the stick is available in individual disposable tubes packaged 40 to the carton. The inhibitor is soluble in hydrocarbon solvents, and has a melting point of 175° F.

The inhibitor is applied by dropping into the tubing through a lubricator at the well head. On reaching the bottom of the tubing, the stick slowly melts and disperses in the well fluids. During production of the well, a strongly absorbed protective film forms on the tubing, well head and flow-line surfaces. Due to the lingering effect of the inhibitor, treatment of the well may be made at intervals of from two or three days to a week without a significant increase in protection.

For additional information, write the Tretolite Company, St. Louis 19, *referring to* WORLD OIL *item* 134.

135—Brake Blocks

This item supplements Gatke Corporation data as shown on page 1405 of Composite Catalog.



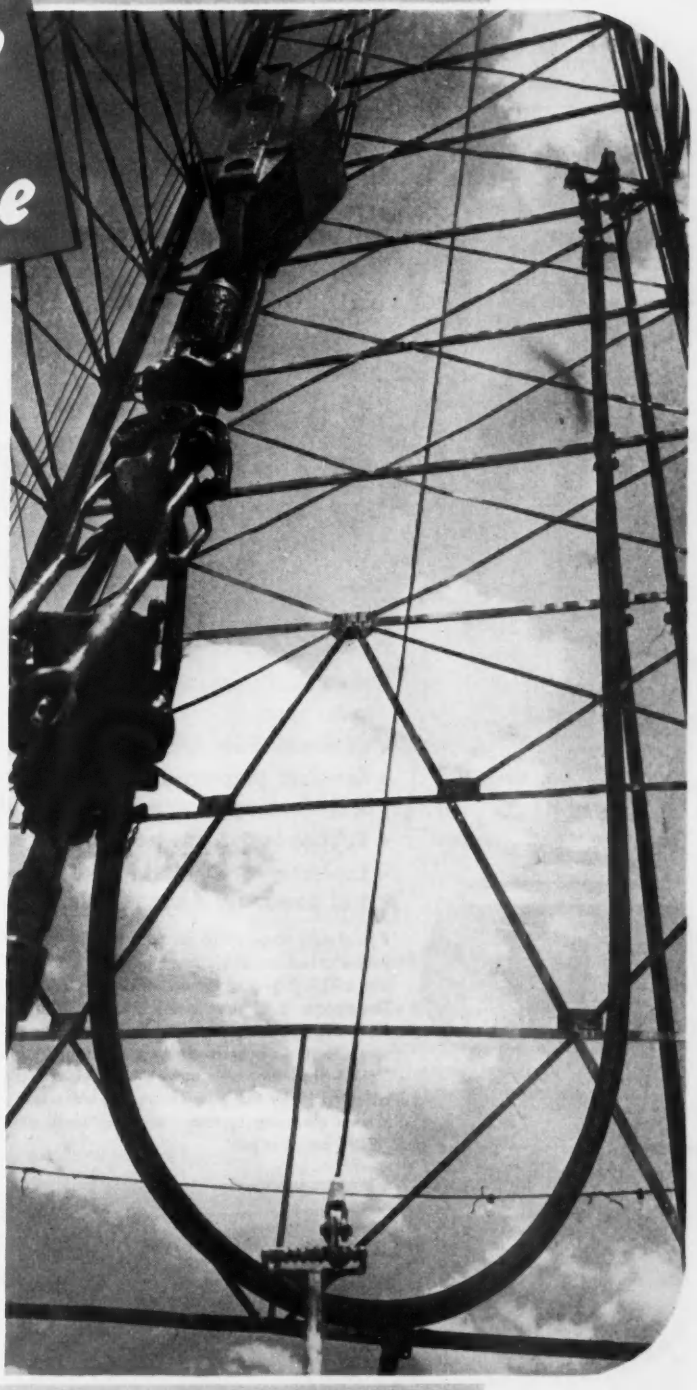
Developed to meet the requirements of flame hardened flanges, MW brake blocks are a combination of the two main types of asbestos friction materials integrally moulded into unified brake blocks. The frictional characteristics of woven asbestos and the long wearing qualities and high heat resistance of moulded asbestos materials are combined.

The blocks are non-compressible and the moulded backing provides secure anchorage, so that bolt heads do not pull out. Engineered for the application, the blocks are moulded to size and flange curvature.

For additional information write Gatke Corporation, 228 North La Salle Street, Chicago 1, *referring to* WORLD OIL *item* 135.

THREE practical hose "kinks" for users of

GOODALL FLEXO LONG LIFE Rotary Hose



Years of experience with all kinds of rotary hose has proved to drilling contractors and oil companies all over the world, that Goodall Flexo Rotary Hose has earned the name "long life." Here are three ways to lengthen that life — to insure even longer, more useful service from your Goodall Flexo Rotary Hose.

- In the event that the hose ruptures behind the coupling — the most common cause for rotary hose replacement — it can easily be repaired by setting the Barney coupling in good hose. The loss in length may be as little as 18 inches. This inexpensive repair job may often save the hose several times before it finally becomes too short.
- If damage occurs near the center of the hose (or if the usable hose is too short), have the couplings reset in short lengths for use as vibrator hose at a considerable saving.
- Then, when the hose is completely used up, the Barney Couplings still have a trade-in value! That important saving is just another reason why Goodall is the first choice among drilling contractors everywhere.

Don't forget the Goodall Service Department — the only complete repair department devoted exclusively to rotary hose!

To get even longer service from your Goodall Rotary Hose, use a swing joint between the standpipe and hose. The extra long service you get from the swing joint installation will reduce hose costs almost to the vanishing point.

GOODALL RUBBER COMPANY
TRENTON, N. J.

GOODALL RUBBER COMPANY OF TEXAS: Houston, Texas
GOODALL RUBBER COMPANY OF CALIFORNIA: San Francisco, Los Angeles, Seattle, Salt Lake City
GOODALL RUBBER COMPANY: St. Paul, Minn.
EXPORT: Goodall Rubber Company, Trenton, N. J.
DISTRIBUTORS: Texas and Louisiana — Houston Oil Field Material Co. Wilson Supply Co., Oklahoma — Iverson Supply Company

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

136—Horizontal Wellchecker

This item supplements Rolo Manufacturing Company data as shown on pages 3720-3721 of Composite Catalog.

A new horizontal wellchecker has automatic water knockout and pilot controls which prevent fluid from ever spilling over into gas line.

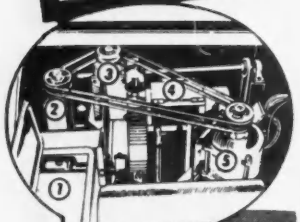
The pilot control prevents the separator from losing fluid seal and also prevents fluid from spilling over into gas run. The pilot will operate on either a fluid or gas supply medium.

The horizontal separator has a series of perforated baffles and a special baffle to hold water, sand or other foreign matter out of the clean oil outlet compartment, which is very advantageous in oil metering. Units may also be furnished with automatic water knockouts when required.

For additional information write Rolo Manufacturing Company, 2510 South Boulevard, Houston, *referring to* WORLD OIL *item* 136.

NEW ALL-ELECTRIC SHALE SEPARATOR and SAMPLE MACHINE

Close-Up View Below Shows Centralized Power "Package": (1) By-Pass (2) Mud-Spray Pump (3) Reduction Gear for Drum Drive (4) Sample Machine (5) Explosive-Proof ¾ H.P. D-C Motor 600-Watt.

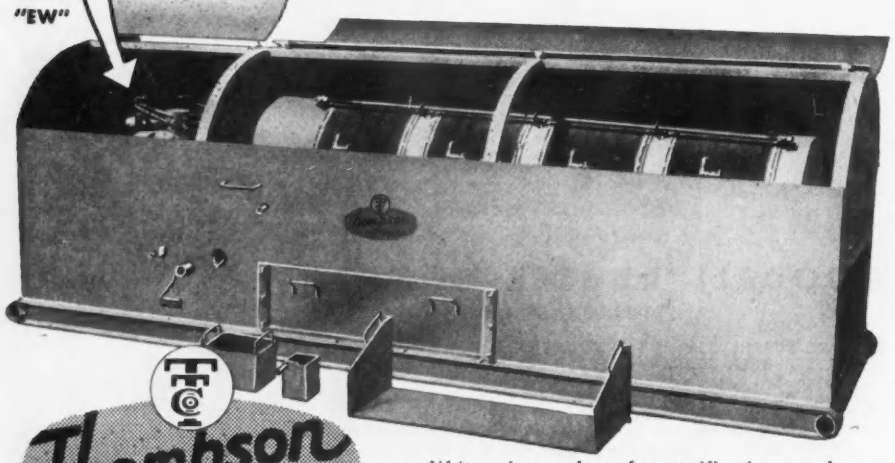


MODEL "EW"

For Deep Well Drilling

- Increased cleaning range: handles muds at maximum pump discharge or deep-hole strings.
- Constant drum speed regardless of mud flow.
- Constant pressure mud-spray system . . . waterless cleaning of screens without altering mud.
- Built-in water jets for alternate screen cleaning.
- Explosive-proof ¾ H.P. D-C motor provides central power for drum rotation and mud-spraying.

Brand new to you but an "old buddy" to Thompson technicians who started months ago to put this precision machine "through the mill." Big pump mud discharge . . . mud strings . . . the Thompson "EW" handles it all in stride. Thompson separators have always done a good job of extracting the shale and abrasives that wear out drilling equipment. The new Thompson "EW" does that and more . . . it cleans the drill mud without altering it, by the new Thompson waterless pressure mud-spray screen cleaning system. Fully enclosed; skid mounted. Put the "EW" on your job!



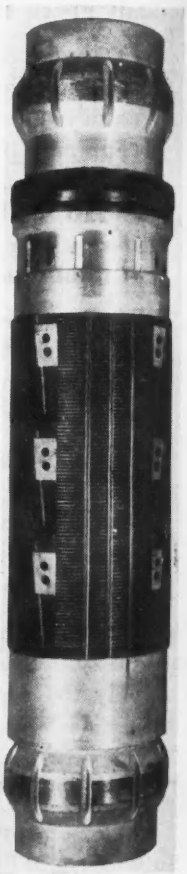
Thompson TOOL CO.

Write, wire or phone for specifications on the complete line of Thompson Shale Separators.

P.O. Box 357 Phone 3521 Iowa Park, Texas

137—Casing Hanger

This item supplements Oil Center Tool Company data as shown on pages 3033-3084 of Composite Catalog.



Putting casing weight down the hole and relieving critical loads on the long, slender unsupported outer casing string on offshore and other water locations is accomplished by the "Down the Hole" casing hanger. Weight is put on the outer string at a point where solid formation supports it. The hanger thus eliminates the column load which causes columns of high slenderness ratio to buckle and bend under load, as well as the chance of dropping the inner strings in case of surface accidents to completed wells.

To set the casing hanger, it is installed in the inner string at the point to be suspended, run in, and the well is cemented. After the cement has set, tension is adjusted on the inner string and blowout preventer rams are closed. The well is pumped between the strings. No rotation is required.

For additional information write Oil Center Tool Company, P. O. Box 3091, Houston 1, *referring to* WORLD OIL *item* 137.

No profit leaks here!

Hewitt Rotary Drilling Hose protects your profits with built-in, leakproof couplings

You're looking at profit protection in the making!

This Hewitt craftsman is building a leakproof coupling into a Hewitt Rotary Drilling Hose. He is building the coupling *into* the carcass of the hose, thereby making it an integral part of the hose wall. This assures a high-pressure seal and a completely rubber-lined, unrestricted fluidway throughout the entire hose. And it eliminates the need for external clamps!

But this profit-protection feature is only one of many which make Hewitt Rotary Drilling Hose so popular among oil men everywhere.

For example, its tough yet flexible carcass effectively withstands high pressures. And its strong cover resists stripping action and abrasion.

So choose the type of Hewitt Rotary Drilling Hose best suited to your needs . . . Monarch for deep well drilling, Ajax for medium well drilling, Conservo for slim hole drilling.

Write for detailed information. Address Hewitt Rubber Division, 240 Kensington Avenue, Buffalo 5, New York. Or consult your nearest Hewitt distributor listed below:

Mid-Continent Supply Company
Norvell-Wilder Supply Company
Jarecki Manufacturing Company
Standard Supply & Hardware Co.
Bethlehem Supply Co. of California

HEWITT

ROTARY DRILLING HOSE

Hewitt offers the oil industry a complete line of special hoses

For oil drilling:

- Rotary Drilling Hose
- Flexible Vibration Hose
- Mud Pump Suction Hose

For oil refining:

- Oil Suction and Discharge Hose
- Sea Loading Hose
- Barge Loading Hose
- Fire Hose
- Flue Cleaning Hose
- Steam Hose

For oil distributing:

- Tank Car Hose
- Tank Truck Hose
- Fuel Oil and Distillate Hose
- Gasoline Pump Hose

also Propane-Butane Hose for all types of service

HEWITT RUBBER DIVISION **HEWITT-ROBINS INCORPORATED**

NOW 3 FINE
Jimmie Gray
COMPOUNDS

INSURE
LONGER LIFE FOR
TOOL JOINT THREADS

EXCLUSIVE 500 TON SPECIAL

You can always break the joint when you use Jimmie Gray Compounds! Each one is engineered to do certain specified jobs best!

KANT-GALL TOOL JOINT COMPOUND

Both new compounds have the same dependable quality, the same money-back guarantee as the widely used Jimmie Gray 500 TON Special!

LONG-LIFE DRILL COLLAR COMPOUND

SOLD BY SUPPLY STORES EVERYWHERE

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✓ SPEEDIER PENETRATION
and...
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...for sale
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for rent or sale
✓ SERVICE ENGINEERS

DIAMOND OIL WELL
DRILLING COMPANY
MIDLAND, TEXAS
815 Midland Tower Phone 2710
OKLAHOMA CITY, OKLA.
Phone 62-1538

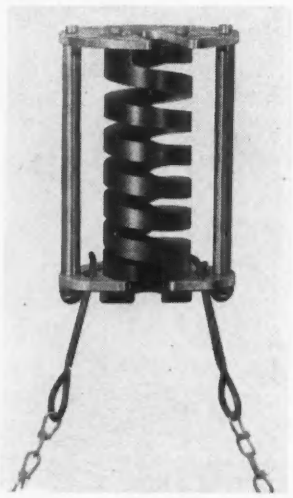
NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

138—Wire Line Wiper

This item supplements Patterson-Ballagh data as shown on pages 3421-3488 of Composite Catalog.

A new wire line wiper which will wipe any size wire line from one-eighth to seven-eighths inch features easy adjustment to wire line diameter, quick drainage of fluid, safety linkage that releases when line pulls tool out of the hole, and spark-proof construction.



The spiral or helical wiping element, which acts as seven individual wipers, presents a continuous wiping edge 15 inches long that conforms to the regular lay of the wire line. Wiping edge follows and wipes clean the small spiraling channels formed by individual cables that make up wire line.

For additional information, write Patterson-Ballagh, Division of Byron Jackson Company, P. O. Box 2493, Terminal Annex, Los Angeles 54, *referring to* WORLD OIL *item* 138.

139—Shutoff Valve

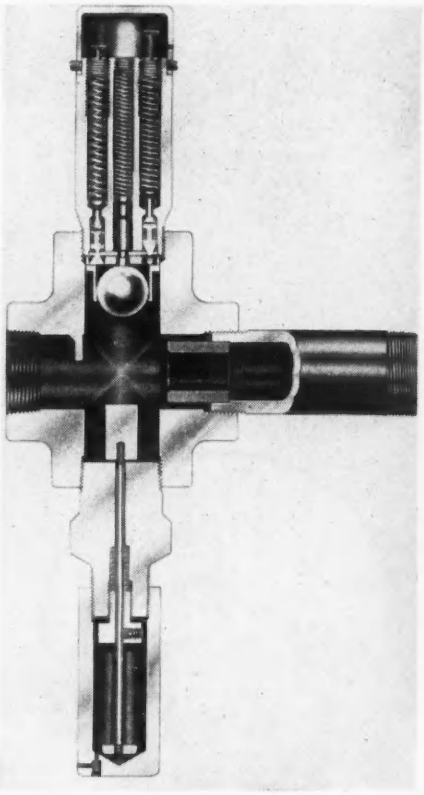
This item supplements W-K-M Company, Inc., data as shown on pages 4181-4188 of Composite Catalog.

Installed on the Christmas tree downstream from the choke, a double-acting safety valve that automatically closes against any predetermined high or low pressure protects the flow line and separator against excessive well pressure, and prevents loss of fluid or gas from the well in event of line failure.

Designed especially for installation on marine wells where regulations require precautions against fluid loss and pollution, the valve never exhausts supply gas or fluid to atmosphere. In event of an oil or flow line break, caused by storms, dragging anchors of passing ships or other factors, pressure in the line drops and the valve automatically shuts off flow from the well. Fluid loss, pollution and fire hazards are reduced, since it takes some time to close the well manually if no shut-off valve is used.

All wells flowing into one central point can be shut off by opening one master control valve at the point of separation. Opening of this master valve drops the pressure in all lines and the valve at each individual well automatically closes.

The valve is used on high-pressure wells that are likely to cut out the chokes, and in areas where paraffin or



ice in the flow lines create pressure hazards. It is available for opening and closing pressures ranging from five to 3000 pounds per square inch.

For additional information write W-K-M Company, Inc., 221 Roberts Street, Houston, *referring to* WORLD OIL *item* 139.

FEED WATER
ENGINEERING

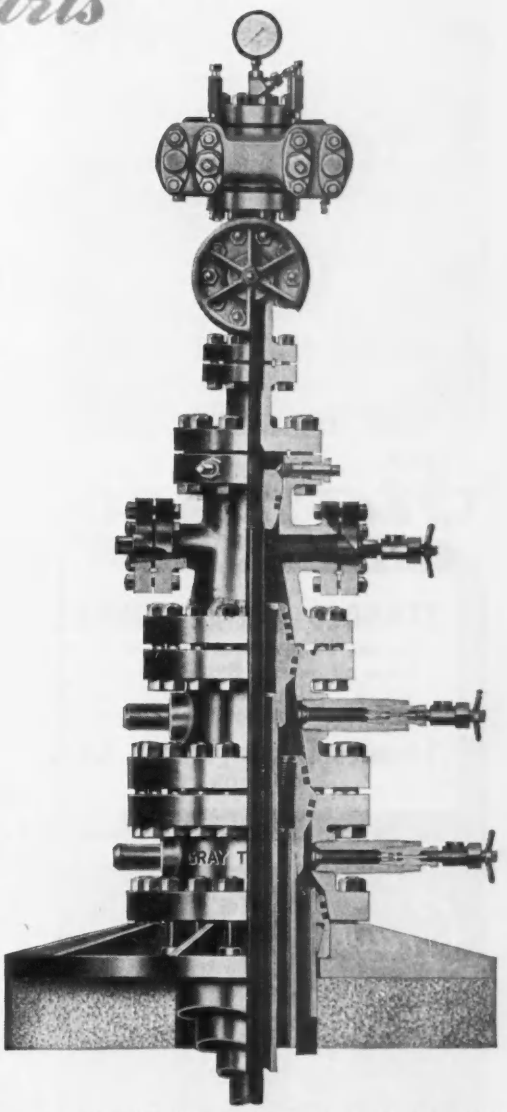
For high boiler efficiency and low maintenance, investigate our feed water engineering service. Prevents scale formation . . . protects boiler from corrosion . . . prevents caustic embrittlement.

25 Years Successful Experience

GULF ENGINEERING CO., INC.
"Service, Not Promises"
1682 INGEBORG ST. HOUSTON, TEXAS
916 S. PETERS STREET NEW ORLEANS, LA

Fine Individual Parts plus COORDINATION

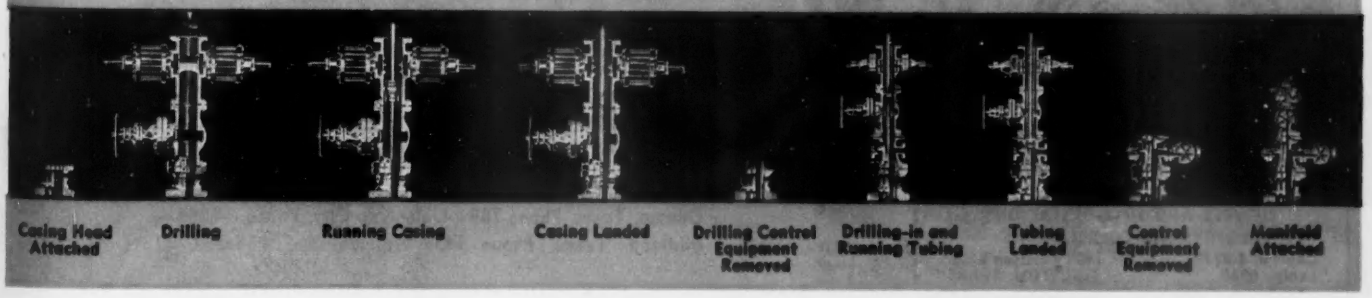
Gray Systems of Well Control are the result of a planned procedure which studies operating conditions, each operation as it is to be performed, the equipment required to perform it, and the coordination and concentration of this equipment into a smooth sequence of operations. This assures the operator the highest degree of control, economy, flexibility and safety in the entire sequence of operations from drilling through producing the well.



Complete Well Head Assembly equipped with Type 3170 Composite Manifold, Valve Removal, Installation and Renewal and Boll Weevil Casing and Tubing Hangers.

GRAY TOOL COMPANY
HOUSTON

Export Representative: **GUY E. DANIELS, 30 Rockefeller Plaza, New York City**
Rocky Mountain Representative: **CARL MOULDEN, P. O. Box 1890, Casper, Wyoming**



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Contracts accepted for domestic and foreign projects, using the most improved instrumental and interpretative technique.

William M. Barret, Inc.

Consulting Geophysicists

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SHREVEPORT, LOUISIANA

Standco
NO-SMOKE

STANDCO BRAKE LINING

For the easiest brake known. It feeds off evenly. Standco never scores brake rims. See Pages 3608-3613 Composite Catalog.

Standco Brake Lining Co.
HOUSTON

Gravity Surveys

COASTAL OIL FINDING COMPANY

Established 1928

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HOUSTON LABORATORIES

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Podbielniak Gas Analyses, Oil Field Brines, Waters, Cores, Muds, etc. Reservoir equilibria studies for crude and condensate wells.

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Consulting Geologist and Geophysicist

AERIAL MAGNETIC AND MICROMAGNETIC SURVEYS AND INTERPRETATIONS
GEOPHYSICAL CORRELATIONS

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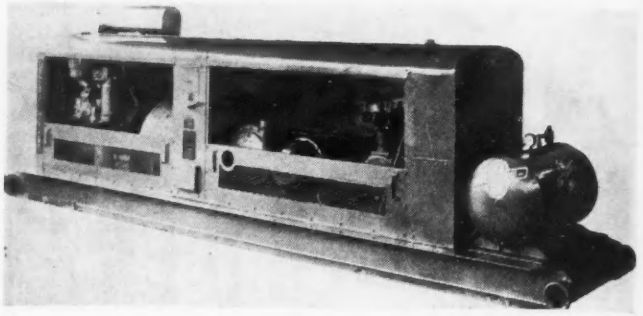
1404 Esperson Bldg. HOUSTON, TEXAS

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

140—Utility Unit

This item supplements Stewart & Stevenson Services, Inc., data as shown on pages 3991-3995 of Composite Catalog.



Service difficulties common to mechanically driven oil field utility units are eliminated in a new self-contained, all electric unit, which consists of an engine driven (diesel or gas) 20 kilowatt lighting generator, a centrifugal water pump, an air compressor, and, if desired, an electric welder.

The generator, which can be furnished for either alternating or direct current, supplies current for the splash-proof, ball bearing electric motors which drive the accessories. The system eliminates the necessity for line shafts, pillow block bearings, flexible couplings, and line shaft clutches.

Skid-mounted for portability, the unit is covered with light weight sheet metal with removable side panels.

For additional information, write Stewart & Stevenson Services, Inc., 4516 Harrisburg Boulevard, Houston, *referring to* WORLD OIL *item* 140.

141—Packer

This item supplements Larkin & Company, Inc., data as shown on page 2184 of Composite Catalog.

A modified upside down packer features a new design which provides for two methods of packer release.

This new packer, known as the "PRM" Upside Down Packer, is recommended for holding pressures on input injection wells with either air, gas or water drives. Other applications include the acidizing of production wells by use of acids under pressure and for plugging purposes with various types of gel under pressure.

Normal removal of the packer is accomplished by lowering the tubing and turning it to the right to hook the body pin in the horizontal position in the "L" slot. The packer can then be pulled.

In cases where it is impossible to lower the tubing, the packer can be removed by removing the tubing nipple. This nipple is furnished with right and left hand threads, and the left hand connection is screwed into the bottom section of the lower packer member at the factory. After the nipple is unscrewed the packer can be removed by use of socket.

For additional information, write Larkin & Company, Inc., Butler, Penn., *referring to* WORLD OIL *item* 141.

BOWEN REMOVABLE SWIVEL ROPE SOCKETS

FOR SWABBING AND BAILING

Split Liner Type

These handy rope sockets prevent a fire hazard as they can be babbitted away from a well. They can be removed from the line without cutting the line or melting the babbitt.

The split liner type allows the babbitted line to pass through the Inner Assembly of Bowen Automatic Line Wipers and the solid liner in the other model will pass through the crown blocks.

Both models may be fitted for ½", 9/16" or ⅝" line and are 1⅝" O.D. Connection is 1-1/16" O.D., A.P.I. Sucker Rod Pin.

Also made in other popular sizes.

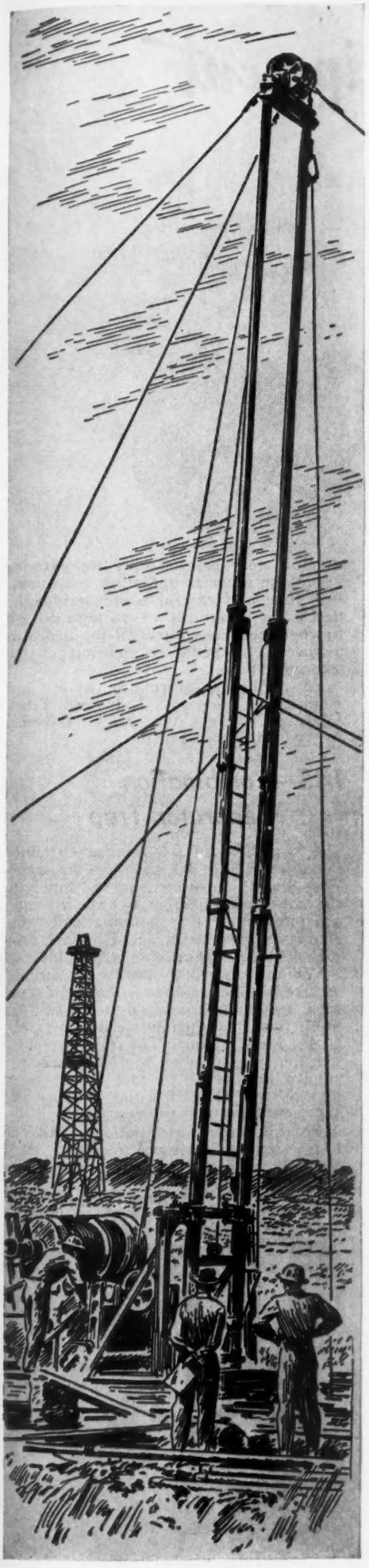
Complete instructions are furnished with each socket. Catalog with detailed information will be furnished promptly when requested. See Bowen Co. of Texas' Section 1948 Composite Catalog.

Through Supply Stores anywhere in the U.S.A.

BOWEN CO. of TEXAS, INC.

Office: 2429 Crockett St., P. O. Box 1025, HOUSTON 1, TEXAS, Phone A. 8-4568
Odessa, Texas, Phone 789—Oklahoma City, Phone 6-8087—
Midland, Texas, Phone 1439—Houma, La., Phone 6709

Solid Liner Type



New...Safer...
More Efficient Torpedo Service
Du Pont Special Oil Well Explosive No 1

OFFERS MANY ADVANTAGES

This new oil well explosive—another product of Du Pont Explosives Research—earned immediate approval in the field. First of all . . . it is safer . . . performs more efficiently . . . and reduces overall shooting costs.

Results indicate greater fracturing range with reduced shattering of well-bore walls...promoting increased flow of oil while reducing clean-out time and expense. The blasting action of this new explosive is unaffected by variations in hydrostatic pressure or by penetration of well fluids.

Extensively tested in many fields and under all conditions for which it is designed . . . this new explosive proved superior for increasing oil production.

Du Pont S.O.W.E. #1 (Special Oil Well Explosive) costs no more than other explosives. Operators who try it continue to use it, recognizing that its value lies in greater economies through increased safety . . . reduced clean-out costs . . . and greater production increase.

Ask any user about his results or ask your American Glycerin Section representative for complete information about this new, specially designed oil well explosive.

AMERICAN GLYCERIN SECTION

Explosives Department

E. I. du Pont de Nemours & Co. (Inc.), Tulsa 3, Oklahoma

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

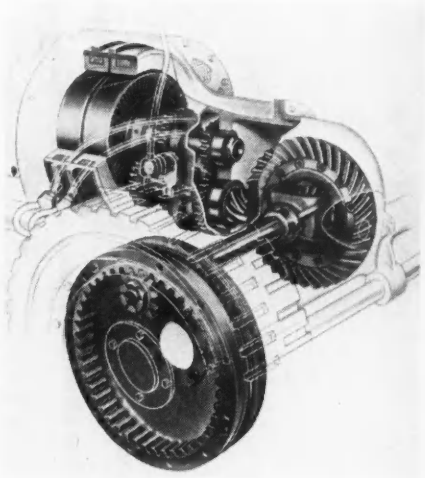
OTHER NEW AND IMPROVED *Equipment*

142—Magnetic Induction Drive

"Dynatork Drive," a development for propelling fork-lift trucks, transmits driving force from engine flywheel to constant-mesh two-speed gear set by magnetic induction through air gap, thereby eliminating the need for a clutch.

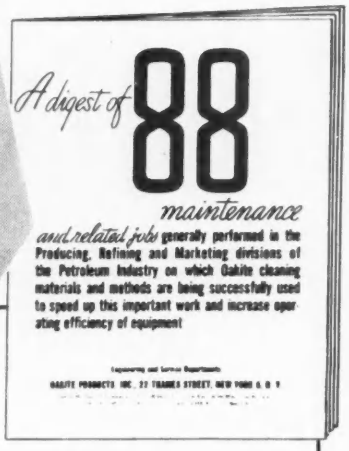
Two magnetic coils are mounted within the flywheel and are surrounded by magnetic poles. They rotate with the flywheel and are the driving members—one coil for "forward," and the other for "reverse." Two rotors attached to a special forward-and-reverse constant-mesh gearing, are the driven members.

A selector-switch on the steering column provides finger-tip control of the fork truck movement. Two gear ratios are provided and selection is by means of a hand lever. Normally, the truck performs all its functions in high; the low gear is used only for extreme grades or unusual operating conditions. For slow and careful maneuvering, the necessary variations of voltage to the flywheel coils is controlled by means of a special footpedal to the left of the steering column.



For additional information write Clark Equipment Company, Industrial Truck Division, Battle Creek, Mich., *referring to* WORLD OIL *item* 142.

this FREE book shows you how to speed up 88 cleaning jobs . . .


A digest of 88
maintenance
and related jobs generally performed in the Producing, Refining and Marketing divisions of the Petroleum Industry on which Oakite cleaning materials and methods are being successfully used to speed up this important work and increase operating efficiency of equipment

IF YOU PREFER . . .

. . . on-the-spot technical advice on your cleaning problems may we suggest you get in touch with the Oakite Technical Service Representative in your neighborhood. Close as your 'phone he's able to work out efficient answers to your cleaning problems. His services are yours for the asking.

You'll find the Oakite Petroleum Digest (shown above) a big help for simplifying oil production cleaning jobs.

That 28-page digest offers step-by-step data for fast cleaning of pipe lines, pumping and drilling equipment, storage tank interiors and exteriors with effective Oakite materials. It gives you facts about Oakite compounds and time-saving Oakite methods for desludging and descaling heat exchange units. Tells about economical ways to clean tubes of gas lift oil wells. Outlines three economical ways to strip paint. Also gives information designed to help you cut costs on truck fleet maintenance. Can you use a copy?

Send request for

FREE OAKITE PETROLEUM CLEANING DIGEST to:

OAKITE PRODUCTS, INC., 37 Thames St., NEW YORK 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE 1909 1949 40th ANNIVERSARY YEAR

OAKITE

REG U S PAT OFF

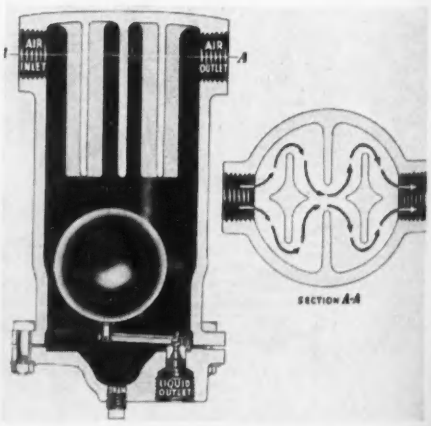
PETROLEUM SERVICE DIVISION

143—Combination Separator Trap

A compact unit to remove entrained moisture and condensate from air supply lines diverts moisture from air supply to the collecting chamber, where the integral ball float trap automatically discharges it into the drain. Pressure drop through the separator is negligible.

While designed primarily for air line service, the Series 430 combination separator trap can be used on steam and gas lines. It is furnished in five sizes: ½-, ¾-, 1-, 1¼- and 1½-inch. The trap is good for working pressures up to 150 pounds per square inch on the ½- and ¾-inch sizes, and up to 200 psi on the 1-, 1¼- and 1½-inch sizes.

For additional information write The Clark Manufacturing Company, 1830 East 38 Street, Cleveland, *referring to* WORLD OIL *item* 143.



TAKES THE "STING" OUT OF LINER CEMENTING

BROWN

LINER CEMENTING METHOD

gives you complete control of the cement— you always know where it is!

For the first time, you can cement liner without dangerous errors in calculated displacement or locating cement.

Through complete control of the movement of the cement, THE BROWN METHOD OF LINER CEMENTING has overcome the weaknesses of customary liner cementing procedure, to effectively remove the "sting" of bad liner jobs.

The Brown Method of Liner Cementing employs two plugs. The first, a liner wiper plug, is secured to the liner setting tool stem by shear pins. The second, a pump down plug, is supported in the Brown Duplex Cementing Head until ready to drop with the top of the cement column.

The Brown FLOAT-N-FILL shoe used on the lower end of the liner will substantially reduce running-in time. A landing collar for the pump down plug is placed in the string as close to the shoe as desired, and the proper length of liner interposed between liner hanger and landing collar. Scratchers and centralizers can be used in the usual manner.

The FLOAT-N-FILL shoe allows the string to be filled from the bottom with properly conditioned mud as rapidly as conditions permit.

As soon as sufficient cement has been pumped into the hole, the Pump Down Plug is released, following the cement down the hole and marking the top of the slurry at all times. When contacting the liner plug on the setting tool stem, the slip ring on bottom of the Pump Down Plug engages the liner plug, which is indicated immediately by an increase in pressure on the gauge at the surface. At approximately 750 lbs. over circulation pressure the pins shear and the two plugs move down the liner, forcing the cement ahead of them. The plugs wipe the liner clean of cement down to the landing collar.

When the plugs bump the landing collar a rapid rise in pump pressure is registered, indicating the cementing operation is complete.

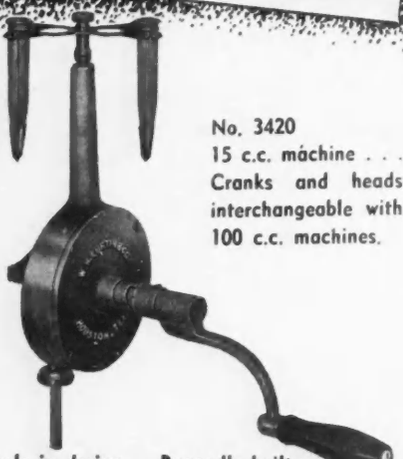
The two plugs latched in the landing collar form a back pressure valve to prevent the back-flow of cement into the liner when the pump pressure is removed. Radial strain on the liner is thereby eliminated while cement is setting.

Due to the bridging effect of the two plugs reverse circulation can be carried on and excess cement pumped out of the hole without applying pressure to the formation.

Numerous liner cementing jobs have been successfully completed by the Brown Method. Full details will be furnished on request. Write, Brown Oil Tools, Inc., Sales Office, State National Bank Bldg., Houston 2, Texas. Export Sales: Acme Well Supply Co., 19 Rector St., New York 6, New York.

BROWN OIL TOOLS, INC.

QUICK, ACCURATE RESULTS
LESS EFFORT
Curtin CENTRIFUGES



No. 3420
15 c.c. machine . . .
Cranks and heads interchangeable with 100 c.c. machines.

Simple in design . . . Ruggedly built . . . Requires no special care . . . Great Ratio and throw of crank produce required speed with no strain. Curtin Centrifuges meet all *A.S.T.M. Standard Method D-96* and *A.P.I. Code No. 25* requirements. Fully descriptive literature upon request.

W·H·CURTIN & CO.
HOUSTON . . . . NEW ORLEANS.

FORMICA Bushings say
STOP-

to
Electrolysis!

Give your pipe line longer life! Formica Bushings . . . used by leading gas companies . . . effectively insulate pipes, positively prevent electrolytic corrosion. They're tough and strong, have constant dielectric strength, and retain their dimensional stability even under extremes of temperature. Write for illustrated data sheet.

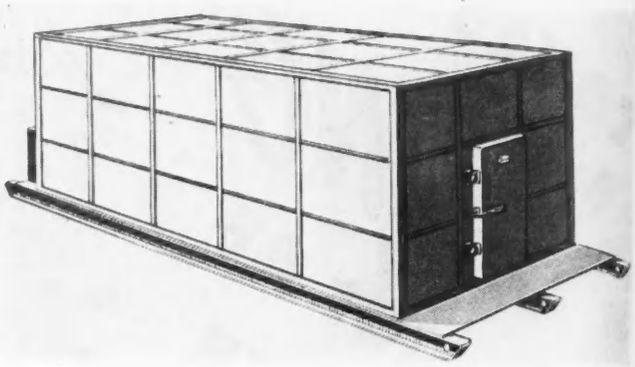
Seven standard sizes for ¼ x ½ to 3 x 4 reducing couplings; wrench-land styles in ¾" and 1" sizes . . . and all are ready for prompt delivery.

THE FORMICA CO.
4680
Spring Grove Ave.
Cincinnati 32, O.
Territories Open

Productive
FORMICA
at Work in Industry

OTHER NEW EQUIPMENT

144—Reefer



Designed to transport frozen foodstuffs to construction and exploration crews, the zero cargo reefer is constructed so that two reefers can be loaded and secured to the hatch of a Liberty ship or similar vessel to transport from 20 to 30 tons of foodstuffs per voyage.

The reefers are of heavy steel welded construction and are insulated and refrigerated to produce 0° F. storage temperatures. The self-contained refrigerating machinery is of the low pressure type using safe Freon-12 refrigerant. It is air-cooled to conserve use of water.

The reefer is constructed on a steel diamond plate deck, which in turn is mounted on heavy I-beam skid equipped with heavy lifting and towing eyes. It can be lifted with full load.

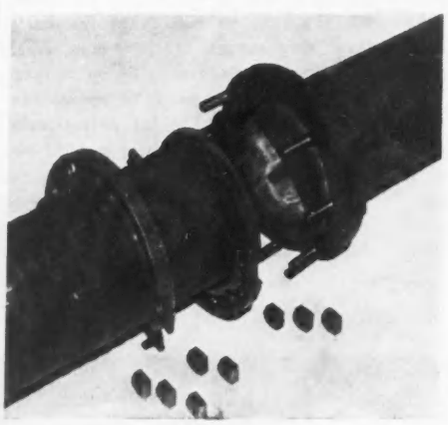
For additional information, write Refrigeration Engineering Corporation, 2020 Naudain Street, Philadelphia, *referring to* WORLD OIL *item* 144.

145—Oil Hose

A complete new line of oil hose for barge and inland waterway loading and unloading is now being manufactured. All the hose, designated as Types 725, 525 and 325 are equipped with Flexseal ends and split flanges to speed connecting and disconnecting hose lines so that the tie-up time of the barge is lessened.

A long section of the largest diameters in the new hose can be handled by two men, and the couplings can be made fast by one man without turning, tugging or twisting the hose. No gaskets are required. The elimination of conventional heavy nipples and flanges brings savings in weight and allows the hose to be flexible from flange to flange.

Substantial weight savings have also been made in the body, through a new type construction. The hose is made with oil- and gasoline-resistant rubber compounds, and has a built-in static wire which protrudes from the ends for grounding. The carcass includes strong, service resistant fabric. The covers are oil, gasoline, abrasion and age resistant, in black, and resist the effects of sunlight or other weathering.



All types except the 325 are reinforced with round steel wire imbedded in the rubber and covered by one or more plies of rubberized fabric.

Type 725 will be manufactured in four-inch size with four plies, six- and eight-inch sizes in five plies, and 10-inch in six plies, all recommended for full vacuum and 100 pounds working pressure in discharge service.

Type 525 is made in the same sizes and plies as Type 725, recommended for full vacuum and 50 pounds working pressure in discharge service.

Type 325 is made in four-inch size, five plies, six- and eight-inch sizes, six plies, 10-inch size, seven plies, and is recommended only for discharge service with working pressure of 50 pounds.

All the hose is made in lengths up to 50 feet, except 10-inch size which is made in lengths up to 25 feet.

For additional information, write The B. F. Goodrich Company, 448 South Main Street, Akron, O., *referring to* WORLD OIL *item* 145.

Red Top
(Hydrostatic)
BAILER
A QUICK, POSITIVE LOAD, REGARDLESS OF FLUID LEVEL.
Ideal also for fishing small objects—widely used for drilling in (completing) wells, and for drilling cement or plastic plug overages.
REYNOLDS SPECIALTY COMPANY, INC.
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Office: 804 Erie St., Phone 7-7511
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Factory: 2202 Greenwood Rd., Phone 2-2023
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JENA, Hayes Lumber Co.
DELHI, Hayes Lumber Co.
RODESSA, Republic Supply Co.
Arkansas:
EL DORADO, Cox Supply Co.
Texas:
HENDERSON, J. C. Philippi, Mgr. East Texas Div., Phone 9716-J1
SERVICE, B. & H. Pump Co., Turnertown
HOUSTON, W. A. Swink, Phone Wydown 9-2858
CORPUS CHRISTI, A. S. Baylor, Phone 2-2461
Kansas:
GREAT BEND, Moss Scranton, Phone 312

THE OUTSTANDING WIRE ROPE FOR OIL MEN

THE ONE THAT LASTS LONGEST ...that's the most economical wire rope you can buy! And "Blue Center" Steel—made only by Roebling—gives wire rope that *extra-long* service life. With Roebling Preformed "Blue Center" you save dollars that really count.

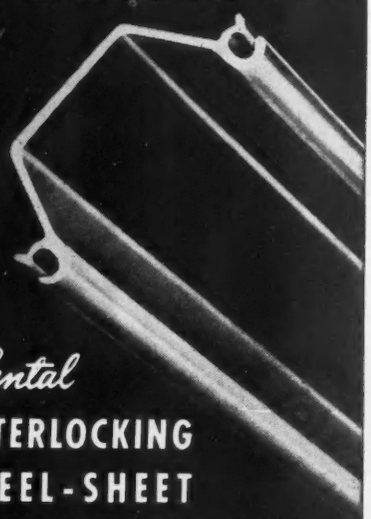
To this, add the other advantages of Roebling Preformed wire rope. It's not inclined to twist and kink . . . is easy to handle and install. It can be cut without seizing. Broken wires stay flat and don't injure sheaves or drums.

You can have full confidence in Roebling rope . . . it is the accepted "standard" in industry today. There's a type and size of Roebling Preformed "Blue Center" Steel Wire Rope for every purpose. Have your Roebling Field Man recommend the best one for your requirements . . . and show you economical methods of installation and maintenance. John A. Roebling's Sons Company, Trenton 2, N. J.

Distributed by: **The National Supply Company**
Republic Supply Company

ROEBLING
☆ A CENTURY OF CONFIDENCE ☆

FOSTER'S



Rental
INTERLOCKING
STEEL-SHEET
PILING
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EXTRACTORS

A COMPLETE
STEEL WAREHOUSE
SERVICE
SINCE 1902

RAIL
TRACK ACCESSORIES
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SINCE 1902

L. B. FOSTER
COMPANY

PITTSBURGH 30 NEW YORK 7
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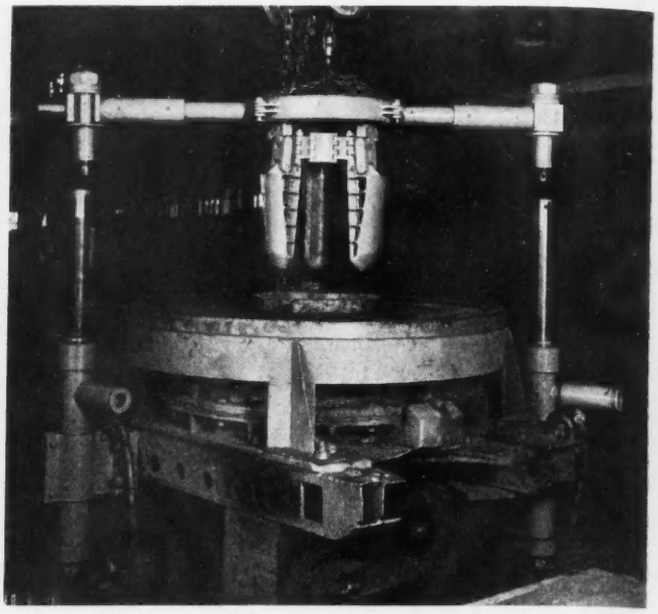
Five convenient warehouses for prompt delivery

Write for Folder F-102

146—Power Slips



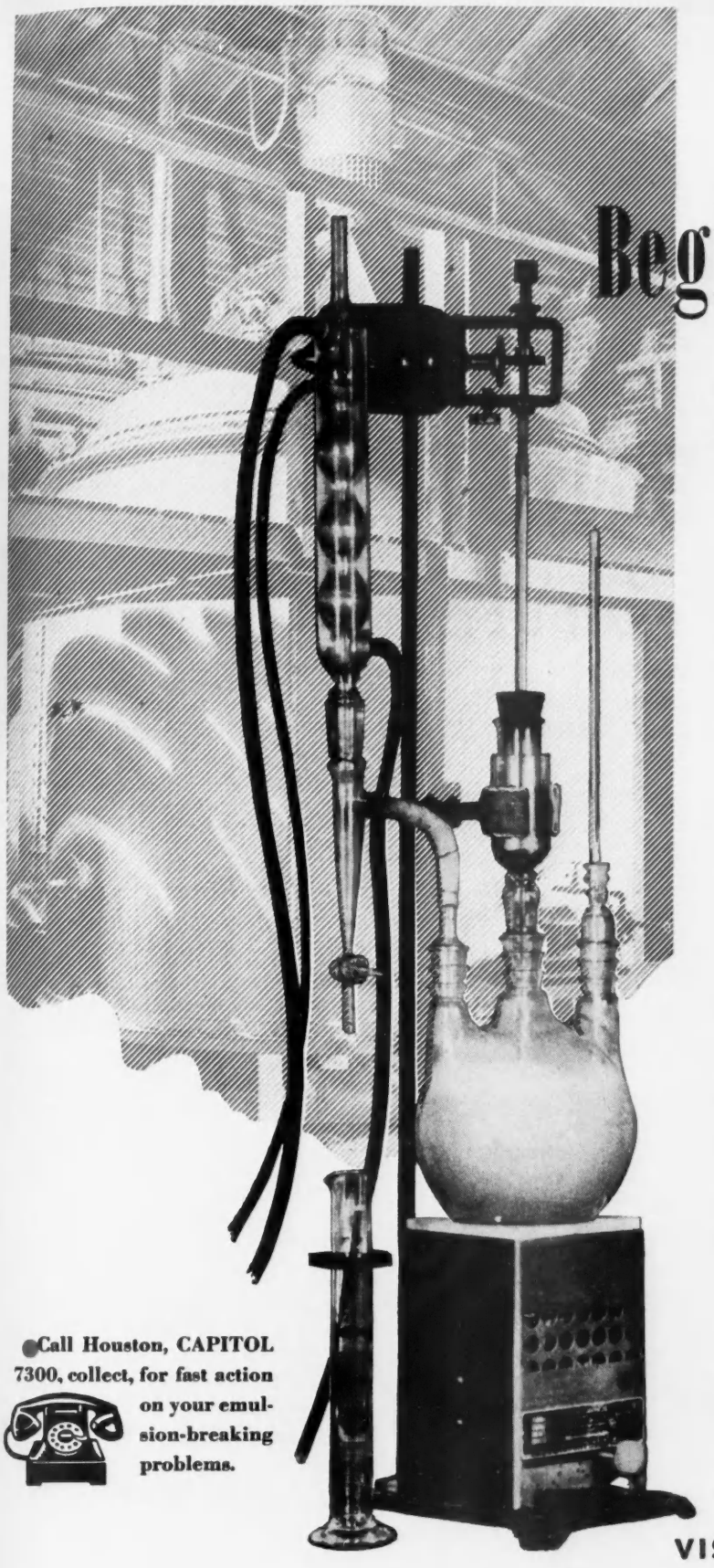
To assure greater personnel and equipment safety in drilling, two new features have been added to the DeCo "Balanced" Power Slips. Because a clear floor is the most important point to consider for safety during drilling operations, the operating cylinders have been lowered so that the stuffing box is below floor level. By means of toggle pins the operating piston rods are segregated so that the slip assembly may be taken off the rig floor and the pistons let down below floor level. Floor plates to cover piston openings are provided.

A feature called "leveling links" provides a connection between each of the three slip segments, for an even, non-crushing grip and coordinated and synchronized operation.

The power slips can be installed on jackknife rigs in the same manner as installed on deep hole power and steam rigs.

For additional information write The DeLaney Company, 6119 East Montgomery Road, Houston, *referring to* WORLD OIL *item* 146.

HOT FORGED FROM SOLID STEEL BARS!
TIME AND TOOL SAVER!
CATAWISSA
HOT FORGED STEEL
LUG NUT UNION
CAN BE APPLIED WITH EITHER A HAMMER OR WRENCH!
For all piping purposes requiring a quick opening and quick closing union, here is time and tool economy without sacrificing efficiency or dependability! Triangular shaped lug nut eliminates distortion or breaking (straight surface for hammer prevents glancing blow), gives you quick, easy application without thread crossing or sticking!
1" TO 4" SIZES WITH FULL ACME THREADS IN THE UNION NUT
STANDARD WEIGHT to 3000-lbs. O. W. G.
DOUBLE EXTRA HEAVY to 6000-lbs. O. W. G.
DISTRIBUTED BY
OIL WELL SUPPLY COMPANY
BRANCHES SERVING ALL OIL FIELDS
WRITE FOR BULLETIN 10-A
CATAWISSA VALVE & FITTINGS COMPANY CATAWISSA, PENNA.



Beginning of a New *Visco* Formula

to Solve Your Emulsion-Breaking Problems . . .

● **Visco Laboratory apparatus pictured here may contain a new or improved formula that will be a better answer to your emulsion-breaking problems. Visco has never been satisfied to slow down research for new and improved emulsion-breakers — even though fast, efficient emulsion-breaking at low cost per barrel of dry oil is what oil men have come to expect whenever they see the big blue Visco barrels.**

Whether your emulsion-breaking is simple or complex — Visco's modern service is the easy, *sure* way to get permanently successful results. Call today for a Visco Representative to give you full details.

●**Call Houston, CAPITOL 7300, collect, for fast action on your emulsion-breaking problems.**

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INCORPORATED
City National Bank Building
Houston 2, Texas

Visco **CONSISTENTLY EFFICIENT DEHYDRATING AND DESALTING CHEMICALS**

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating compounds for use in the breaking and resolving of oil emulsions, and to grant licenses for such use under the following United States patents: 1,459,562; 1,856,563; 1,932,510; 1,937,259; 2,050,639; 2,050,640; 2,206,189; 2,214,783; 2,214,784; 2,225,189; 2,303,414; 2,307,813; 2,318,934; 2,318,935; 2,321,056; 2,335,554 Re 20,737 and patents pending. Any purchaser of Visco-ized Treating compounds is authorized to use the same in the treating, breaking and resolving of oil emulsions in accordance with the above patents. The royalty for such use is included in the purchase price. Visco Products Company is authorized to and is willing to grant licenses on a royalty basis, to all companies and to others desiring to practice the patented subject matter, under any and all of the above patents, permitting the user to purchase the oil treating compounds at will from any vendor, and to prepare the compounds for use under the above patent or patents, at a royalty charge of 20 cents per gallon. Application for license should be made to **Visco Products Company**, Houston, Texas.

147—Heat Exchangers

Illustrations and pertinent data on the complete line of re-designed Ross "BCF" exchangers are presented in an eight-page booklet giving full treatment to the Ross mass-produced exchangers. Cut-away views illustrating construction, and line drawings showing sizes, dimensions and weights accompany brief text on various applications of this all-nonferrous unit.

For a copy of this bulletin write to Ross Heater & Manufacturing Company, Inc., 1407 West Avenue, Buffalo 13, N. Y., *referring to* WORLD OIL *item* 147.

148—Safety and Relief Valves

Catalog 48, a 72-page, illustrated book, covers complete data needed in connection with the installation and use of safety and relief valves.

For a copy of this catalog, write Farris Engineering Corporation, 480 Commercial Avenue, Palisades Park, N. J., *referring to* WORLD OIL *item* 148.

149—Exhausters and Compressors

A new bulletin, 4-E, describes the complete line of SK steam jet exhausters and compressors for use in connection with pump priming, exhausting, evacuating, cleaning, transporting and agitating liquids and gases.

For a copy of this bulletin, write to Schutte and Koerting Company, 12th and Thompson streets, Philadelphia 22, *referring to* WORLD OIL *item* 149.

150—Turbo Pumps

The four-page Bulletin "S" describes Coffin types CC and CG pumps. The pumps are used for boiler feed duty, condensate (high pressure), oil refinery charge, and other instances where compact, rugged design with high-speed, high-pressure operation is required. The bulletin gives cross-section illustrations of the pump, running gear, governor detail, and pictures of other Coffin pumps, including Types "F," "G," "B," and "BL."

For a copy of this folder, write J. S. Coffin, Jr., Company, 326 South Dean Street, Englewood, N. J., *referring to* WORLD OIL *item* 150.

151—Wire Rope

An illustrated handbook, "Wire Rope is a Machine," gives men on the job a simple and straightforward explanation of how wire rope works, how it should be operated, and how to select and order correct wire rope construction for long service life on the job.

For a copy of this handbook write Wire Rope Sales, Jones & Laughlin Steel Corporation, Jones & Laughlin Building, Pittsburgh 30, *referring to* WORLD OIL *item* 151.

152—Tools

S. R. Bowen Company has revised and improved the operation and maintenance manuals on the following Bowen tools: junk baskets, jars, jar testers, safety joints, overshots, sockets, spears, line wipers and bumper subs. These manuals contain complete specification sheets on the tools and accessories.

For copies of these manuals, write the S. R. Bowen Company, Santa Fe Springs, Calif., *referring to* WORLD OIL *item* 152.

153—Valves

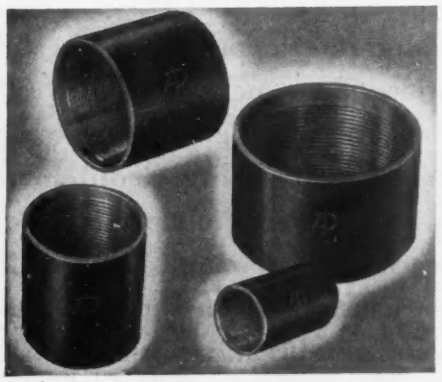
A 12-page, illustrated bulletin, Ross No. 311, on Full-Flo, In-line Valves, describes and diagrams large and small three-way and straightway valves. The large are solenoid air-pilot operated and the small are direct solenoid operated. They are suitable for machine tools, jigs and fixtures, etc. Applications for use with water and low air pressures are also described and typical installation diagrams are included.

For a copy of this booklet, write Ross Operating Valve Company, 120 Golden Gate Avenue, Detroit 3, *referring to* WORLD OIL *item* 153.

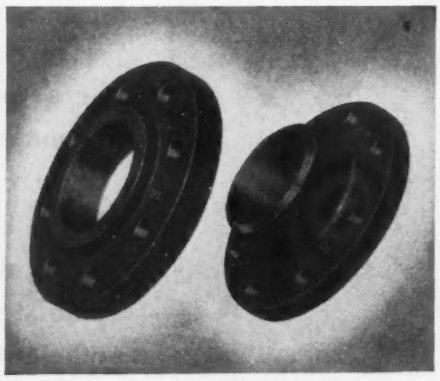
FIRST because they're FINEST

Harrisburg Steel OIL FIELD PRODUCTS

Tough enough to take it under all field conditions . . . time-tried in all branches of the petroleum industry . . . Harrisburg Steel oil field products have 96 years of manufacturing experience behind them.



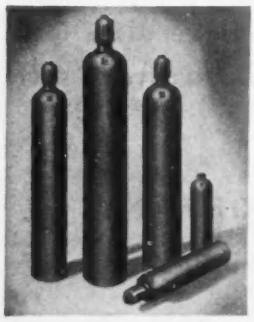
Made to A.P.I. Specifications



Made to A.S.A. Standards

SEAMLESS STEEL PIPE COUPLINGS Threaded on special machines assuring accuracy of form, height, angle, and lead. Threads electro-galvanized. Will not gall under the severest strain.

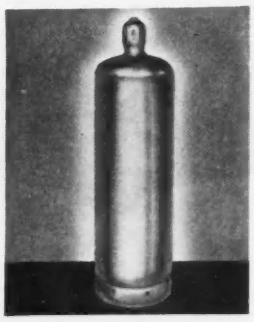
DROP-FORGED STEEL PIPE FLANGES Thread accuracy assured. They are perfect in height, angle, taper, and gauging—meeting the most exacting requirements of field engineers.



DID YOU KNOW?

Harrisburg Steel is the world's largest producer of Seamless Plate-Made High-Pressure Gas Cylinders to I.C.C. specifications.

We have just introduced our Lite-Weight Propane Cylinders . . . 100 lbs. capacity, tare weight 72 lbs. Made to I.C.C. 4BA-240



Write for catalogs, prices, and data on these products

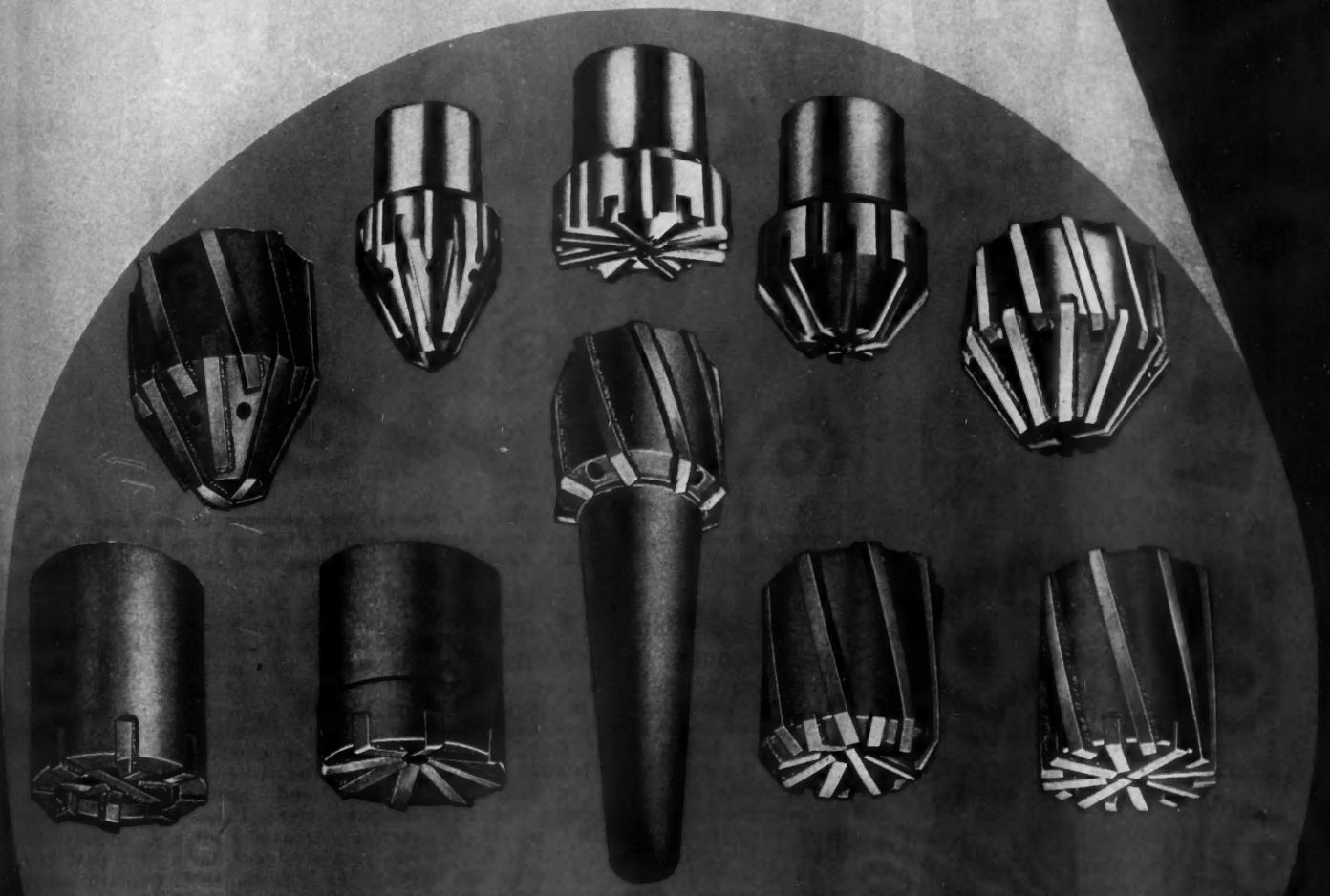
Harrisburg 96 YEARS IN PENNSYLVANIA'S CAPITAL

STEEL CORPORATION

HARRISBURG 8, PENNSYLVANIA

TROUBLE SHOOTERS

Kinzbach Mills efficiently handle those important operations involving cutting casing windows, milling up pipe and tools in the hole or shaping their ends for subsequent passage of fishing tools.



Kinzbach Mills provide operators with the most efficient tools ever designed for clean, consistent cutting and milling operations. Check these features for the advantages they offer.

(1) Bodies are of high quality steel, properly shaped for required operations and with proper top connections for the cutting string.

(2) Insert blades are of high speed tool steel, heat-treated and precision ground for greatest cutting efficiency.

(3) Spiral setting of blades gives uniform cutting depth, lessening the danger of twist-offs.

(4) Special mills for specific jobs can be furnished in addition to the regular types shown above.

Contact Kinzbach on your milling problems . . . their double-tough "Trouble-Shooters" will handle the roughest jobs.

KINZBACH TOOL COMPANY, INC.

P. O. Box 312 HOUSTON, TEXAS Phone Capitol 9436

Export Office: 74 Trinity Place, New York, N. Y.

KINZBACH

Dependable Milling Tools

CM
HERC-ALLOY
STEEL CHAIN

1ST on the market
1ST in safety
1ST in economy
1ST in sales to users who want the best

A mighty helpful booklet if you use Herc-Alloy Steel Chain.
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(Affiliated with Chisholm-Moore Hoist Corp.)
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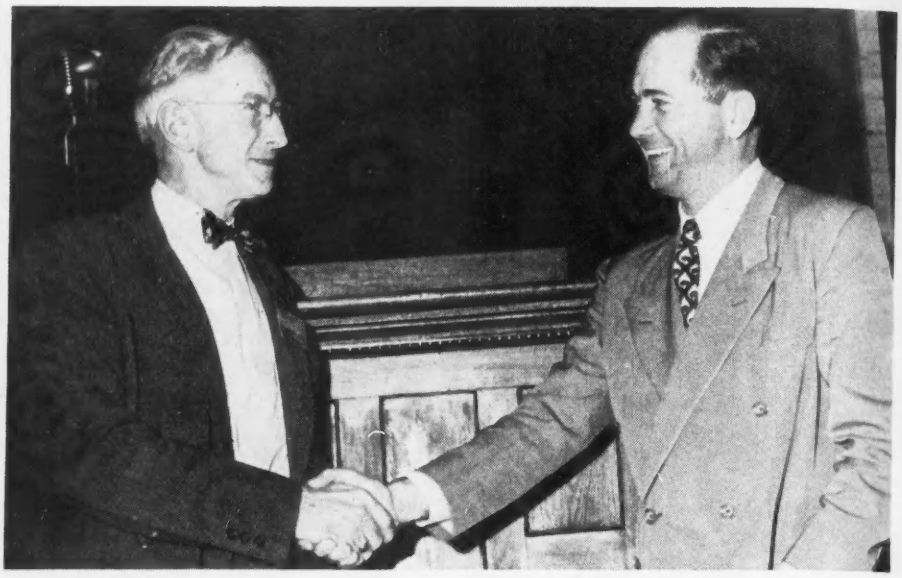
Other Factories at Angola, New York,
St. Catharines, Ont. and Vereeniging, South Africa

Associations



SPEAKS AT CONFERENCE—William J. Murray, right, chairman of the Texas Railroad Commission, is welcomed to the Petroleum Recovery Conference held at Texas A. & M. College, by Harold Vance, head of A. & M.'s Petroleum Engineering department. Murray was one of the speakers.

Petroleum Conference Examines Texas' Secondary Oil Reserve

Production of the known secondary oil reserve would mean an estimated monetary return to Texas of approximately $2½ billion, Paul D. Torrey, president, Lynes, Inc., Houston, told the Petroleum Recovery Conference at Texas A. and M. College. An estimated partial secondary reserve in the state of 3377½ million barrels of oil, is equivalent to almost 30 percent of the proven primary reserve of the state, Torrey pointed out.

"The secondary reserve is equivalent to 3.75 years of current oil production, which will be available, when the oil may be produced economically, over a much more extended period," Torrey said.

William J. Murray, Jr., chairman of the Texas Railroad Commission said that conservation of "our natural resources" is of paramount importance. He pointed out that under recent court decisions the commission can step in with authority, as a last resort, and enforce the "application of secondary recovery methods." He urged the industry, the landowners and the royalty holders, to institute by and among themselves a cooperative program, to conserve the natural resources "for everyone's good and for their own betterment."

Exploration Geophysicists Elect Gilmour President

The Society of Exploration Geophysicists at its annual convention in St. Louis elected Andrew Gilmour of Tulsa president, and George E. Wagoner of Shreveport vice president. Kenneth E. Burg was elected secretary-treasurer, and Richard A. Geyer of Houston, editor of the Society's bulletin *Geophysics*.

Gilmour is chief geophysical supervisor for the Amerada Petroleum Corporation and has been with that company since 1922. He is a former secretary-treasurer of the society and was vice president during the past year. Wagoner is manager of exploration for the southern division of The Carter Oil Company at Shreveport. Burg is consulting geophysicist with Geophysical Service, Inc., and Geyer is research geophysicist with Humble Oil & Refining Company.

Gas Short Course Planned

A short course is scheduled at the University of Tulsa for June 1-3. Technical sessions will be divided into Natural Gas and Liquefied Petroleum Gas groups. Entertainment for the registrants and equipment exhibits will be featured. The course is offered by the college of Petroleum Sciences and Engineering of the University of Tulsa, and is sponsored by the Southern Gas Association.

Information Chairman Named

C. R. (Dick) McPherson, manager, Sovereign Service, Inc., Wichita, Kansas, has been named 1949 chairman of the Kansas Oil Industry Information Committee's statewide speakers' bureau.

THERE'S A NEW LITTLE YELLOW PUMP . .

The "Easy-Flow" Rex!

- IT'S NEW
- IT'S DIFFERENT
- IT'S DURABLE
- IT'S EFFICIENT
- IT'S LIGHT
- IT'S FAST
- IT'S HANDY

Light weight . . . outstanding durability . . . top efficiency, the new Rex "Easy-Flow" Pump gives you all three and then some. It's the ideal pump for oil field utility service.

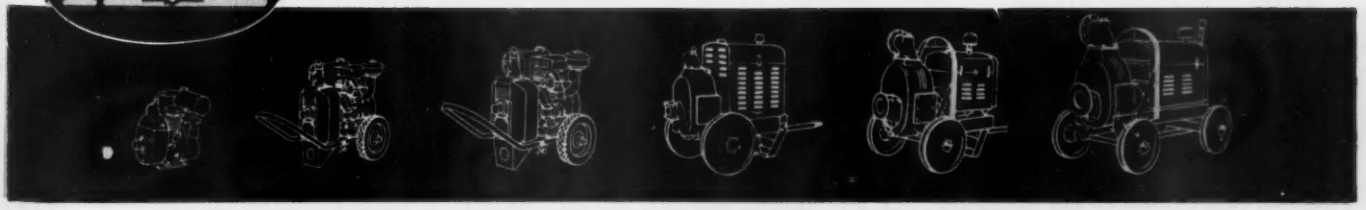
The pump body is press-formed of Armco Ingot Iron, famous for resisting rust and corrosion. This new body won't crack or shatter under heavy blows . . . or in freezing weather.

The Rex "Easy-Flow" Pump is the fastest priming, most efficient pump in the field today. The press-formed body and volute have smoother surfaces, assuring faster flow of water through the pump. There is no re-circulating shut-off valve, eliminating wasteful re-circulation. If damaged, body can be repaired by welding.

Combine all these advantages, plus the famous Rex adjustable Z-Metal Peeler and Z-Metal Impeller, and it's easy to see why you'll get a new high in long service life.

For all the facts, see your Rex Field Engineer, your local Supply Store, or write Chain Belt Company, 1639 West Bruce St., Milwaukee 4, Wis.

REX **OIL FIELD PUMPS**

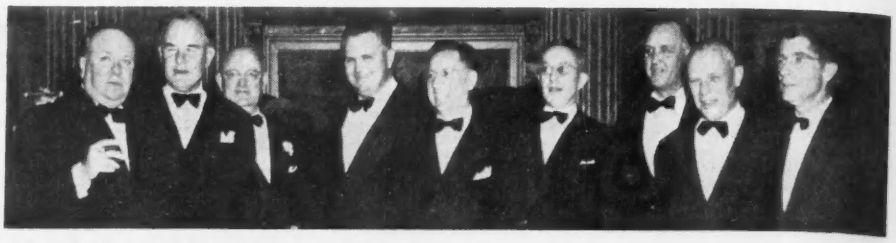


CHAIN BELT COMPANY of MILWAUKEE

Three Members Are Appointed To API Awards Committee

New members of the API Committee on Awards appointed for terms of three years each are Robert H. Colley, The Atlantic Refining Company, Philadelphia; Harry T. Klein, The Texas Company, New York City; and A. C. Mattei, Honolulu Oil Corporation, Ltd., San Francisco.

Hines H. Baker, Humble Oil & Refining Company, Houston, was named to the vacancy occasioned by the death of Harry C. Wiess. This term expires December 31.



LOS ANGELES NOMADS OFFICERS—Officers and directors of the Los Angeles Chapter of Nomads are, left to right, Bob Eiche, regent; Fred Ripley, past president; Ted Forsythe, deputy sergeant-at-arms; Tommy Johnston, sergeant-at-arms; Lee Laird, president; Earle Boggess, vice president; Jerry Engstrand; By Landis, past secretary; and Knight Templeton, assistant treasurer.

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On drilling rigs the world over more Foster Catheads are in operation than all other makes combined . . . including the majority of rigs which have set new drilling depth records from year to year. This preference logically stems from design and operational advantages which assure maximum safety, dependability and economy.

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In this, as in an increasing number of the oil country's toughest bearing assignments Aetna excellence unfailingly pays off . . . helps to avoid costly town-time . . . to pare down maintenance expense . . . to stretch equipment life. For money saving, problem solving counsel on oil country bearing applications, submit your prints to Aetna. No obligation, of course!

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More Than 500 Will Attend 19th IPAA Mid-Year Meeting

Accommodations for more than 500 oil men will be provided at the 19th mid-year meeting of the Independent Petroleum Association of America May 2-3 in New Orleans.

Fred W. Shield, president of the Association, has named William Helis, Jr., vice president for southern Louisiana, general arrangements chairman for the meeting at which current oil industry trends will be aired by the nation's independent operators.

Other local committee appointments include E. C. Bateman, finance committee; H. L. Carnahan, entertainment; Mrs. H. L. Carnahan, ladies' entertainment; Gordon Atwater, reception committee; Scott Wilson, attendance and publicity; C. J. McCoy, registration; and I. R. Price, transportation.

Senator Schoeppel to Address Compact Commission Meeting

U. S. Senator Andrew F. Schoeppel will address the spring quarterly meeting of the Interstate Oil Compact Commission in Jacksonville, Fla., May 9-11, it was announced by Governor Frank Carlson of Kansas, chairman. Senator Schoeppel's subject will be "Proper Relationship Between the Federal and State Government in Oil and Gas Conservation."

General sessions of the Compact meeting will open May 10 with the address of welcome by Governor Fuller Warren of Florida, and the response by Governor Sid McMath of Arkansas.

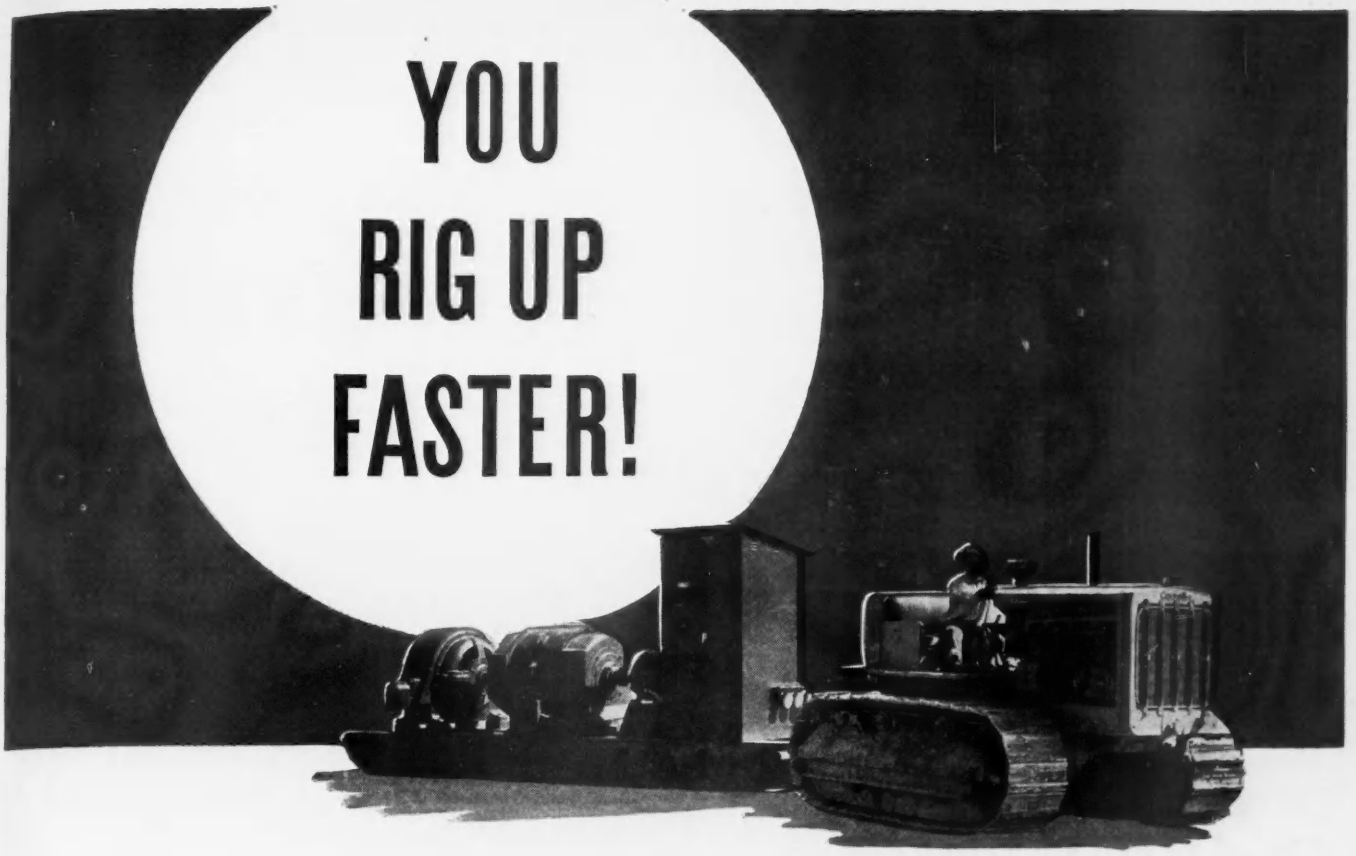
Smith Is Elected President Of Houston Petroleum Club

R. E. (Bob) Smith, independent oil man, has been elected president of the Petroleum Club of Houston. Virgil Brill, president of Highland Oil Company, and Val Billips, general manager of Texas Gulf Producing Company, were elected vice presidents.

Other officers are Marline Sandlin, vice president of Woodley Petroleum Company, secretary, and E. O. Buck, vice president of the National Bank of Commerce, treasurer.

Harris Underwood, Jr., independent oil man who has served for the past two years as president of the club, was made a member of the board of directors.

YOU RIG UP FASTER!



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with a G-E Electrified Rig!

Rigging up is faster and easier with a General Electric electrified rig, whether you buy power or generate your own. Your rig is lighter and more compact, which makes it more easily portable. And with skid-mounting, the electric equipment can be towed by tractor from one site to another—quickly, economically. Excavation work and time is reduced because—with no mechanical connection required between mud-pump and draw-works drives—you can "spot" your mud sumps and pumps to suit the terrain to best advantage, and most economically.

The electrical hook-up is simple. You plug in the control cables. You bolt on your power connections. In double-quick time, you're ready to start spudding-in . . . and on your way to more on-bottom time for your bit, lower cost per foot of hole drilled! Mail the coupon today for more data on the overall economy and control efficiency of electric drilling. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

Main Parts of aD-c Drilling Rig Drive:
Main D-c Generators (right) supply power for draw-works, rotary and mud-pump motors. May be engine- or motor-driven.
Main Controls (upper right) consist of necessary control and transfer switches, relays, and other devices.
D-c Motors (above) are powered by generators, and drive draw-works, rotary table, etc. through speed-reducers.

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GENERAL ELECTRIC

Pacific Coast API Production Meeting Papers Are Announced

Titles have been announced of papers to be presented at the spring meeting of the Pacific Coast District API, Division of Production, May 12-13, Biltmore Hotel, Los Angeles.

Production papers include "Performance of Hydraulic Rod Pumping Units in the Santa Fe Springs Field," by Juan P. Pedretti, Union Oil Company of California; "The Economics of Oil Well Corrosion Control," Robert J. Villagrana and William W. Messick, Standard Oil Company of California; "Some Problems in Oil Well Casing Corrosion," Gordon N. Scott, consultant; "Field Performance of Sand Control Liners in California," E. G. Bemis, Standard of California, and William Ross Cablen, consultant; "Emery West Gas Injection Project," by F. S. Fowler, Standard of California; "Performance of Primary Pressure Control in the First, Second and Third Zones, Newhall Potrero Field," Oran H. Graybeal, Barnsdall Oil Company; and "Relative Permeability of Cores Desaturated by Capillary Pressure Methods," E. R. Brownscome, R. L. Slabod and B. H. Caudle, The Atlantic Refining Company.

Drilling papers to be read at the meeting are "A Method of Quantitative Interpretation of Electrical Logs," M. P. Tixier, Schlumberger Well Surveying Corporation; "Directional Drilling in the Los Angeles Basin," D. L. Roberts, Long Beach Oil Development Company; "Detection of Incipient Drill Pipe Failures," Walter C. Main, Technical Oil Tool Corporation; "Power Requirements for Rotary Drilling Operations," R. W. Craig, The National Supply Company; and "Problems and Methods of Contract Drilling," H. E. Winter, Union Oil Company of California.

North Texas Oil and Gas Men Elect Underwood President

R. Clay Underwood, independent operator, was elected president of the North Texas Oil and Gas Association at the 19th annual meeting in Wichita Falls, Texas. He succeeds George W. Dimock.

R. Clay Underwood

Other new officers include Marvin E. McCullough, Fain and McGaha, first vice president; Charles N. Prothro, Perkins-Prothro Company, second vice president; and Fred Schmann, executive vice president, who was reelected.

Producers and Royalty Owners Vote to Fight Rising Imports

The fight on a national level to limit petroleum imports to any quantity that may be needed to supplement domestic production has been joined by the Texas Independent Producers and Royalty Owners Association. The executive committee, meeting at Austin, instructed a special committee to convey in whatever manner deemed appropriate the association belief that excessive petroleum imports constitute a threat to the safety and well-being of the nation and should be limited by quota restrictions.

Excessive imports were credited by the association with necessitating a cutback in Texas oil allowables of more than 500,000 barrels daily during the past three months. These, said a resolution adopted at the meeting, not only contributed to a sharp decline in exploration and drilling of new wells but are costing the State in revenue alone more than $20 million yearly.

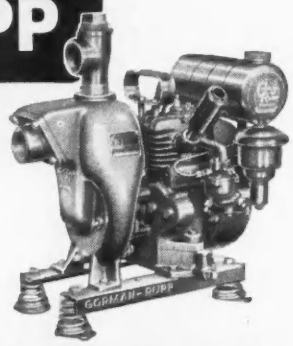
Named immediately to the committee were: Guy I. Warren, association president, Corpus Christi; H. J. Porter, Houston; and Angus Wynne, Longview. Two additional members will be appointed at a later date.

Short Course Is Proposed

Nathan Schofer, Cities Service Refining Corporation, Tutwiler Refinery, Lake Charles, La., is chairman of a committee named by the South Central Region, National Association of Corrosion Engineers, to get a consensus on a proposed short course in corrosion engineering. If sufficient interest is evidenced, arrangements will be made with a university engineering school to hold it this year.

Depend on GORMAN-RUPP

Lightweight PUMPS



Gorman-Rupp self-priming centrifugal pumps are especially designed to meet the toughest requirements of the oil fields. A product of advanced engineering design, yes -- but retaining the same simplicity of construction that has made Gorman-Rupp so outstanding in other fields.

The applications of these pumps around a lease are too numerous to mention. You can get a Gorman-Rupp in any size or capacity to suit your particular requirements.

Gorman-Rupp guarantees satisfaction. No other pump on the market will do more work for its size, power or weight, or for as long a period of time without attention or maintenance. Every pump tested.

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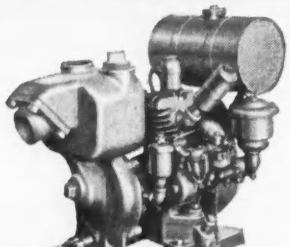
HOUSTON 2, TEXAS

FOR LARGE CAPACITY
THE "MIDGET"
Wt. 62 lbs. -- 5500 GPH



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MODEL 1103
Wt. 60 lbs. -- 3600 GPH

FOR LIGHT ALL-PURPOSE
THE "HANDY"
Electric motor driven
Weight 20 lbs.--1000 GPH

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This popular oil fact-book will give the most complete, up-to-the-minute oil maps and data on world-wide drilling, production, refining and pipe line activity published anywhere at any time.

For everyone who wants to keep abreast of developments in the world of oil, *this is the indispensable, compact encyclopedia.* The oil man engaged in export operations, or planning activities outside the U. S. can scarcely get along without it. Since domestic oil happenings are sensitive to oil happenings in the farthest corners of the earth—the oil man at home had better keep it handy. You'll refer to it whenever you need operating information, whenever you need data on current oil developments in any country.

Your new 1949 *International Operations Issue* will bring you up-to-date on every world oil area, including the United States. Trends will be described, and comparative figures for preceding years will be presented, country by country.

Practically all of the maps will be revised; many of them are being completely redrawn to include the location of new operations, and developments never before released for general publication. The location of oil fields, refineries, terminals, roads, pipe lines—as well as political subdivisions of countries, mountains, rivers and key points—all will be shown on four-color maps.

Assisting WORLD OIL's editors in the preparation of the *International Operations Issue* are oil companies and government petroleum bureaus in many countries. Those who helped in previous years are continuing to do so, and many others, seeing the work accomplished in the first three issues of the *International Operations Issue*, are furnishing data (and in some cases, maps) for the first time.

The greatest variety of world oil facts ever published!

If you need data for your work, if you're stumped for the facts with which to clinch an argument—turn to the 1949 *International Operations Issue* of WORLD OIL. It is your complete *answer* book, the only complete source book on the world of oil today. Every aspect of the *International Operations Issue*—its appearance and its contents—is being designed for YOUR BENEFIT AND CONVENIENCE.

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☐ Producing Company ☐ Manufacturer
☐ Pipeline ☐ Supply

Mid-Continent District API Production Division Elects

J. H. Field, head mechanical engineer, Sohio Petroleum Company, Oklahoma City, was elected chairman of the Mid-Continent district, division of Production, API, at the annual spring conference of the district in Tulsa. He succeeds Lloyd E. Elkins, chief research engineer, Stanolind Oil & Gas Company, Tulsa.

W. R. Gottshall, Continental Oil Company, Oklahoma City, was elected secretary-treasurer to succeed Harold E. Berg, Tide Water Associated Oil Company, Tulsa.

Other officers include W. D. Maxwell, The Carter Oil Company, Great Bend, Kansas; F. F. Kennedy, Stanolind, Pampa, Texas; and Berg, vice chairmen for Panhandle and Oklahoma districts, respectively.

Kansas-Oklahoma Group Elects

Harry A. Trower, vice president of Phillips Petroleum Company, Bartlesville, Okla., has been elected chairman of the Kansas-Oklahoma District of the Oil Industry Information Committee. R. N. Cooper, assistant sales manager, Derby Oil Company, Wichita, Kansas, will assist Trower as district vice chairman.

F. L. La Que

Dr. R. B. Mears

Mears and La Que Receive Corrosion Engineers Awards

Presentation of the 1949 Willis Rodney Whitney Award to Dr. R. B. Mears, and the 1949 Frank Newman Speller Award to F. L. La Que, was made at the annual banquet of the National Association of Corrosion Engineers at Cincinnati. Mears is the incoming president and La Que is the past president of the Association.

The awards are presented to the persons voted best qualified in the field of corrosion science, for the Whitney award, and in engineering, for the Speller award.

La Que is in charge of the Corrosion Engineering section, Development and Research division, International Nickel Company, Inc., New York City. Since 1927, when he joined International Nickel, his principal work has concerned practical aspects of corrosion and the properties of corrosion-resistant metals and alloys. He was instrumental in founding the "Marine Testing Laboratory" at Kure Beach, N. C.

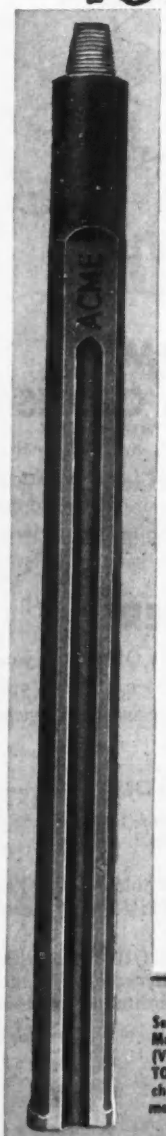
Mears is manager of the research laboratory of the Carnegie-Illinois Steel Corporation, Pittsburgh. He joined the technical staff of the Bell Telephone Laboratories in 1928 and left in 1932 to continue his corrosion studies as Carnegie scholar of the British Iron and Steel Institute. After receiving his doctor's degree from Cambridge University in 1935, he became chief of the chemistry-metallurgy division of the Aluminum Research Laboratory and later was with the development division of the Aluminum Company. He joined U. S. Steel Corporation in 1946 at its research laboratory at Kearney, N. J., and early in 1947 took his present position with Carnegie-Illinois.

Petroleum Exhibits Featured At Southwest Industrial Show

Equipment manufactured for the oil industry, as well as petroleum products and by-products, will be represented at the second annual Southwestern Industrial Exposition, to be held in the Will Rogers Memorial exhibit buildings in Fort Worth May 8-15.

A highlight of the show will be a series of marketing and production clinics to be attended by manufacturers, purchasing agents, consumers and business writers. Displays in the exposition will be limited to goods produced in Texas, Oklahoma, Arkansas, New Mexico and Louisiana.

Use



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Acme "Drilmor" Bits "Bite" Deeper . . . Longer, Because:

There's a half-century backlog of master-craftsmanship that foundations their engineered design . . . for better field-performance and profit.

The mills' billets MUST meet our rigid analysis specifications . . . not over a 5-point range (never the usual 10) is allowed. We pay EXTRA for this exactness . . . but it's THERE —for your greater service margin.

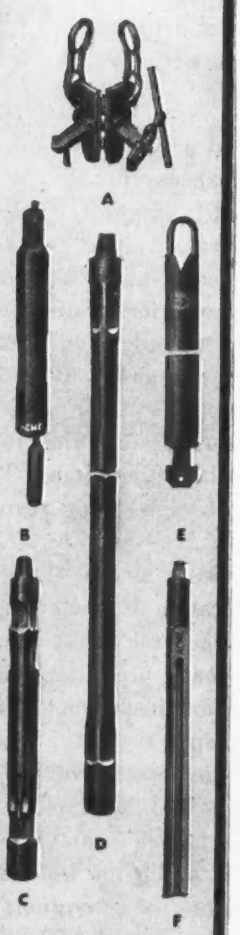
Uniform, tightest-textured forgings assured by our electrically controlled, automatic regulated furnaces. Thus any over-heating is strictly taboo, HERE. EXACT temperature controls also insure CORRECT heat-treatment.

Acme persists in following the "Old School Rule": that Bits MUST have perfectly balanced proportions and trouble-free joints . . . no matter what the EXTRA pains to turn them. A policy which pays off . . . down hole for you . . . in customer Good Will for us.

See Acme's latest Catalog & Manual in Composite Catalog (Vol. 1). Or mail penny postal TODAY for your copy . . . chock-full of valuable information for every Cable Driller.

See other Acme Drilling Tools in panel (right) for more of EVERYTHING you need in a Trustworthy String.

More of EVERYTHING You Need in an Acme String . . .



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B—Prosser Swivel Socket
C—Drilling Jar
D—Drilling Stem
E—Bailer
F—Drilling Bit

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Le Roi Power Unit—Viking Pump Capacity 140 barrels per hour

Southern Engine & Pump Company makes available to you 40 years of "KNOW HOW" in your pumping requirements.

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Sunshine Iron Works knows many a way to beat a tough coat of paraffin . . . and makes a tool for every one! Our Type G Whirling Rabbit brings paraffin right up with it, when dropped to the bottom of flowing wells and forced up by closed-in pressure. S-I-W's Ball Rabbit has multiple scraping edges for full-opening pig action. The S-I-W Ball Dispenser holds a 3-months' supply, and is plunger-operated by the pumper. These and other S-I-W Paraffin Control tools are effective!

TYPE G WHIRLING RABBIT

Men in the Industry NEWS

T. E. Kennerly, Houston attorney, has been elected to the boards of directors of Houston Oil Company of Texas and Houston Pipe Line Company. He fills a vacancy left by the retirement of **B. H. Lang** of St. Louis, who had held the position 22 years.

Kennerly has served for 24 years as general attorney for the two firms. He was also reelected a director, vice president and general counsel of the Southwestern Settlement and Development Corporation, an affiliate of Houston Oil.

»

Benno C. Schmidt, a general partner of J. H. Whitney & Company, New York, and **O. Kelley Anderson,** president of Consolidated Investment Trust and of Boston Fund, Inc., have been elected directors of Transcontinental Gas Pipe Line Corporation.

DAN L. CLARK W. M. AVERILL RUPERT COX

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H. H. Brereton

H. E. Brereton has been appointed vice president of The California Oil Company, a subsidiary of Standard Oil Company of California. Brereton, who has been with California Standard and its subsidiaries for 28 years, started his career in the company's sales department at Los Angeles. Later he was transferred to Standard Stations, Inc., as assistant to the general manager. Brereton is also secretary and treasurer of the California Oil Company.

»

James K. Ellis, vice president in charge of production for Sunray Oil Corporation, has been named to the board of directors. Ellis has been associated with Sunray since 1946 when he became an officer of the company at the time Transwestern Oil Company was merged with Sunray. Ellis had been with the Transwestern organization since 1937. He was engineer and superintendent of production and became a Transwestern vice president and director in 1940, a position he held until he joined Sunray at Tulsa.

He was formerly associated with **T. B. Slick** in building gas-lift plants at Seminole, as production superintendent for Slick, and was later production superintendent for The Carter Oil Company's Oklahoma district.

»

Alfred F. Hagen has been appointed treasury manager for the Houston area of Shell Oil Company, Inc. He replaces **E. R. Mueller,** who has been named manager of Shell's head office Accounting department in New York.

A. F. Hagen

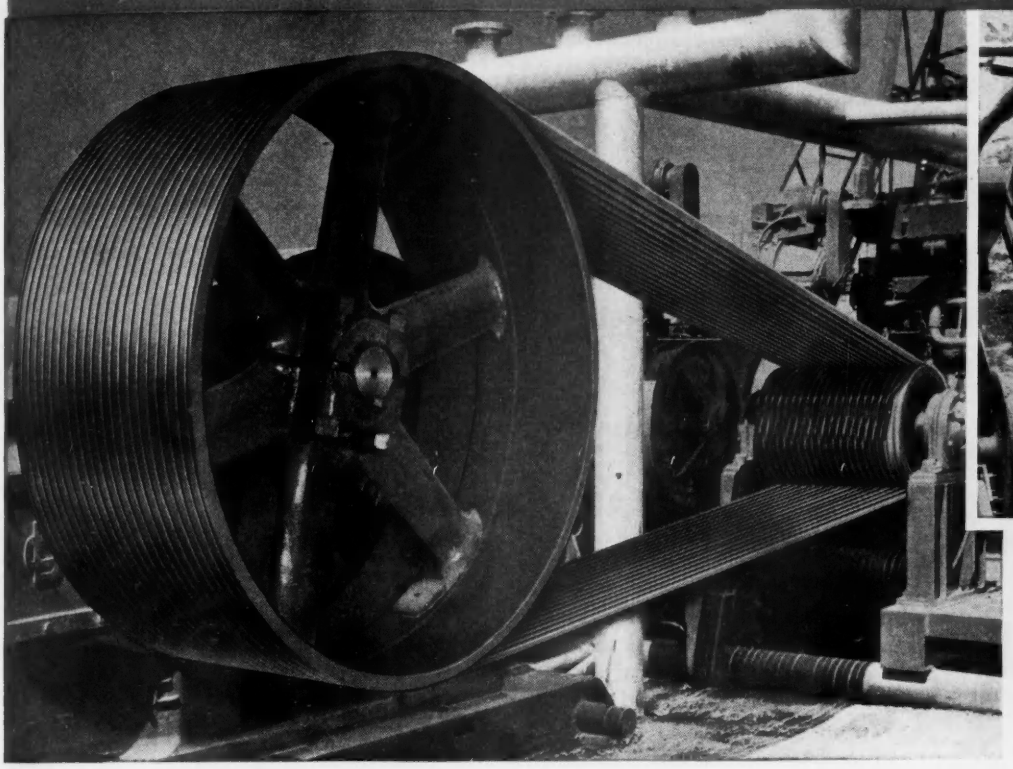
Hagen started as a clerk in 1923 on the Pacific Coast. He has been clerk and chief clerk in production field operations, field auditor and auditor in the Los Angeles and San Francisco offices, and assistant office manager and office manager in the Los Angeles office. In 1945 he was made assistant general auditor in the San Francisco office.

»

Frank Phillips, chairman of Phillips Petroleum Company, has been relieved at his request of active management responsibilities in the company he founded in 1917. Members of the board of directors voted to discontinue the office of chairman of the board and created for Phillips the new title of honorary director and honorary chairman, without voting or management responsibilities.

DAYTON V-BELTS

have LONGER LIFE... GREATER STRENGTH because they're built with RAYON CORDS



For tough oil field service you can't buy a stronger, more rugged V-Belt than the Dayton V-Belt built with Raytex Fortified Cords.

The Raytex Fortified Cords in the strength section of every Dayton V-Belt are specially processed Rayon Cords. They give Dayton V-Belts *minimum stretch, greater flex strength* and *longer life.* And this means less maintenance, longer periods of trouble-free service, more profitable hours of operation in oil field service.

Standardize on Dayton Rayon Cord V-Belts for your toughest oil field jobs. They'll prove themselves quickly . . . deliver unequaled performance day after day, month after month . . . regardless of wind or rain, dirt or dust, high or low temperatures, oil or grease. They're built tough for tough service!

Take advantage of on-the-spot stocks and specialized oil field engineering service by buying your Dayton V-Belts from Continental Supply Company's strategically located branches. Write the Continental Supply Company, Dallas, Texas.

V-Belts by **Dayton Rubber**

THE MARK OF TECHNICAL EXCELLENCE IN NATURAL AND SYNTHETIC RUBBER

SERVICE BY **Continental**

W. W. Fisher, formerly with Stanolind Oil and Gas Company, has been appointed head of Petroleum, Inc.'s land department at Wichita, Kansas.

»

Albert L. Hall, petroleum engineer in the Mid-Continent area, has been named assistant to Richard K. Huey, vice president in charge of production for Deep Rock Oil Corporation.

For the past three years, Hall has been assistant manager of Reno Oil Company in Wichita Falls, Texas. He was also director of Oklahoma Oil Corporation, a Reno subsidiary.

He was graduated in 1933 from Oklahoma University as petroleum engineer. From then until 1946 he was employed by Phillips Petroleum Company, with the exception of three years as an officer in the Navy.

»

Leslie A. Leuzinger has been appointed petroleum engineer in the Rangely field for the Union Pacific Railroad Company's Oil Development, with headquarters at The Texas Company camp in Rangely field.

»

Basil V. Savoy is also with Union Pacific's Oil Development as junior petroleum engineer, headquartered at Rock Springs, Wyo.

Walter J. Osterhoudt, geophysicist and a pioneer in the development of reflection seismograph equipment and techniques, has resigned as supervisor of geophysical operations for Gulf Research and Development Company's Houston division office to enter consulting practice as an exploration geophysicist specializing in the coordination of geological, geophysical and drilling data.

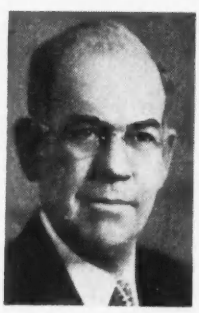
Walter J. Osterhoudt

He has been associated with Gulf since his graduation from the University of Wisconsin in 1930. Since 1939, he has headed Gulf's exploration activities in Texas, Louisiana, Mississippi, Arkansas and Alabama. Osterhoudt is the author of "The seismograph Discovery of an Ancient Mississippi Channel," and "The Use of Electric Logging Equipment in Seismic Exploration."

In 1932 he was made superintendent of field operations for Gulf Research, and in 1933 Osterhoudt took that company's first seismograph party into Mexico, and later into Venezuela. He came to the Houston division as assistant supervisor in 1935 from the Pittsburgh office, and was made supervisor in 1939.

»

C. J. Colby, Houston, has joined Kerr-McGee Oil Industries, Inc., as director of purchases and material, with headquarters in Oklahoma City. Colby will coordinate the purchasing, transportation and materials departments.



C. J. Colby

For the past four years, he has been manager of machinery sales for Republic Supply Company, Houston. Prior to that time he was with International Derrick and Equipment Company for 12 years. During the war he was in Ideco's Columbus office and previously was manager of the company's South Texas division.

»

George E. Dunlap, division land man for Sun Oil Company at Dallas, has been promoted to manager of the company's new Canadian division with headquarters at Calgary, Alberta. **George E. Bentley** will be in charge of field operations.

»

William W. Rice has been appointed manager of the new Special Products department of Deep Rock Oil Corporation, Tulsa. His headquarters will be in Chicago.

»

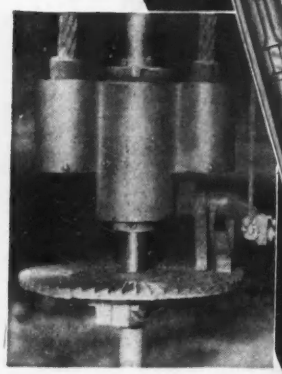
W. G. Noble, former manager of crude oil purchases and sales, has been elected a director of Magnolia Pipe Line Company.

WHAT ARE YOU PAYING FOR PARAFFIN REMOVAL?

TOO MUCH — If your pumping wells are not equipped with HUBER SCRAPERS

Many major companies report Huber Scrapers have completely eliminated paraffin removal costs or reduced them to only a fraction of a cent per barrel of oil produced. Huber Scrapers, shrink-fitted to new or used sucker rods, scrape the paraffin from the tubing wall as the string rotates and reciprocates. Rods are rotated by the special Huber Rotating Rod Hanger.

Reduce or eliminate your paraffin removal costs with Huber Scrapers. Write for latest bulletin.



HUBER ROTATING ROD HANGER

This rod hanger rotates the rod string a fraction of a turn on each reciprocation. Two ratchet levers, operated by a flexible cable extending from the walking beam, engage the teeth in the turntable to turn the rod string.

Sold through supply stores.

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SCRAPE AS THEY ROTATE AS THEY RECIPROCATE

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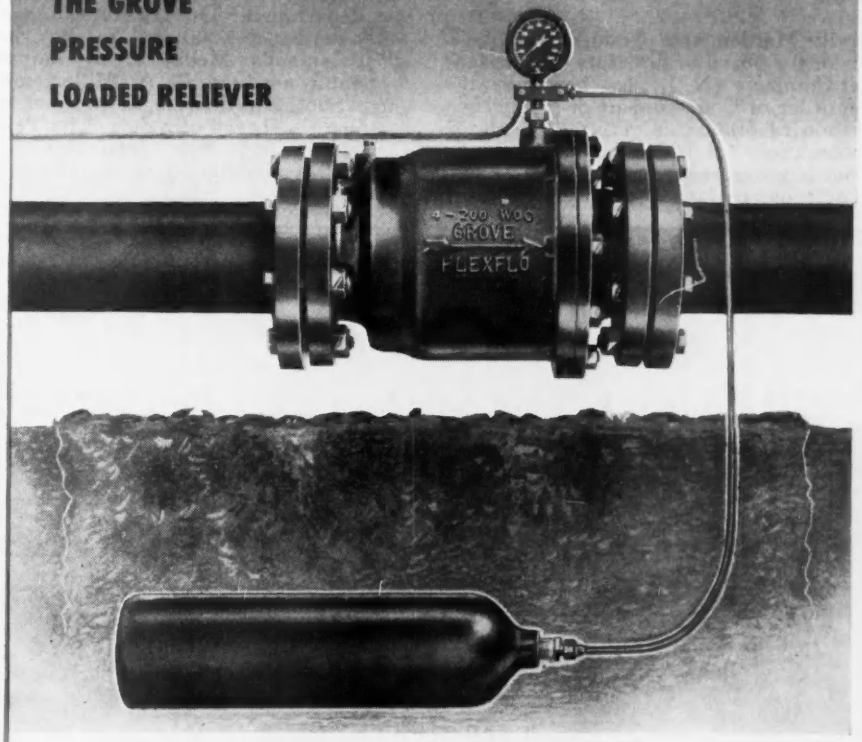
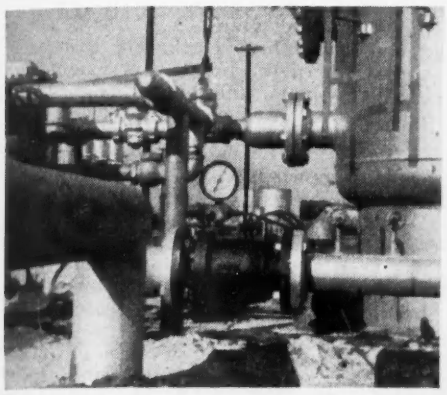
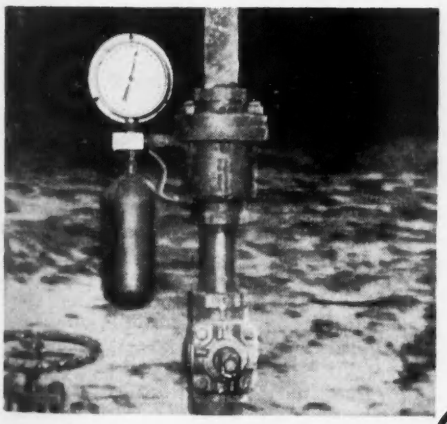
INSTANT RESPONSE
POSITIVE ACTION
BUBBLE-TIGHT SHUT-OFF
LONG SERVICE LIFE

YOU NEED

THE GROVE
PRESSURE
LOADED RELIEVER







The Grove Flexflo Pressure Loaded RELIEVER is appearing all over the oilfields. Oil men are beginning to discover its flexibility —its adaptability as either a Relief Valve or Back Pressure Regulator on constant or intermittent flow. Incorporating all the outstanding features of the Grove Flexflo, the Model 888 gives instant response to the smallest line pressure variation. The rubber-tube is smooth and positive in action, eliminating seepage and leakage . . . offering sure and certain operation when installed in parallel with code-required relief devices.

For ground-insulation against temperature changes, the pressure cylinder can be buried: Where pressure variations due to temperature changes are not important, the cylinder may be attached directly at the Flexflo for ease of installation and maintenance. Self-contained and self-operating, the Grove RELIEVER will give years of satisfactory service, opening and closing thousands of times with no sticking or chattering, no troublesome operation or maintenance problems. Write for full details and application data today.

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PRESSURE LOADED
RELIEVER

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William H. Curry, district geologist for the Atlantic Oil & Refining Company in the Rocky Mountain area for the past six years, has resigned to become vice president and director of the Wy-Tex Oil Company in charge of its Rocky Mountain division with offices at Casper, Wyo.

»

Orville Harden, vice president and member of the board of directors of Standard Oil Company (N. J.), has been awarded the order of Commandeur of the French Legion of Honor, in recognition of the cooperation Harden has given the French government, notably in the field of petroleum. Harden has been an officer of the Legion of Honor for more than ten years.

He started with the company in 1910 as an office boy, and at the age of 35 he was made a director.

»

James C. Weaver, head roustabout at Tomball, South Texas division, Producing department, The Texas Company, was awarded the National Safety Council President's Medal at a company foreman's meeting. **C. A. Miller,** manager, Southern division, Personnel department in charge of Safety, The Texas Company, made the presentation to Weaver in recognition of his efforts in saving a life.

Announcing the

THIRD REVISED EDITION OF

PRACTICAL PETROLEUM ENGINEERS' HANDBOOK

by

JOSEPH ZABA, E.M.M.Sc.

and

W. T. DOHERTY, Ch.E.

This Third Edition of Practical Petroleum Engineers' Handbook has been completely revised and brought up to date.

The First and Second Editions of this book definitely met with a growing demand in the petroleum industry for a practical handbook. However, all handbooks must, of necessity, be revised from time to time to keep pace with developments in the industry for which it was written.

Written by practical oil men, to this edition has been added over one hundred and sixty *additional* pages of information, charts and tables. The tables have been compiled so that they can be used by any one to meet practical field situations without further calculations and will fit most of the working conditions under which the average operator is working in the field.

The authors have maintained their original purpose of presenting information that is readily usable to advantage by men in the field as well as in the office to perform their duties quickly and efficiently.

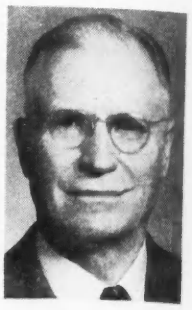
668 pages, 5½" x 8½", Rounded Corners, Semi-Flexible, Imitation Leather Binding, Completely Indexed for Easy Reference. Price: $10. postpaid in Continental U. S.

BOOK DEPARTMENT

THE GULF PUBLISHING CO.

P. O. BOX 2608 HOUSTON 1, TEXAS

C. O. (Cleve) Moss, for the past 20 years with Deep Rock Oil Corporation, has retired to enter the independent petroleum consulting field, with offices in the Midco Building, Tulsa. He will engage in general engineering practice as applied to oil and gas production, with emphasis on valuation and appraisal work.



C. O. Moss

Moss was formerly technical and engineering assistant to the executive management of Deep Rock. He had been supervisor of the firm's gas system and gasoline plants, and had developed reserve estimates of oil and gas.

»

Dave Sheppard, chief scout for Lion Oil Company, has transferred from El Dorado, Ark., to Denver, where he will serve as acting land man. **W. T. Leisk** has been advanced to chief scout. **Tom D. Buchanan,** formerly draftsman, has been promoted to scout. **E. Dade Eaves,** formerly a machine operator at the chemical plant, has moved to the main office to be draftsman in the land office. **Jack Chase,** land man for the El Dorado district, has transferred to Midland, Texas.

»

W. Leo Austin, head of the Mid-Continent Petroleum Corporation's Tax department, has joined Kerr-McGee Oil Industries, Inc. Austin, who is in charge of the Accounting and Tax departments in Kerr-McGee's Oklahoma City headquarters, succeeds **Charles R. Bell,** who resigned to accept a position in Continental Oil Company's Tax department.

W. Leo Austin

Austin was tax counsel and accountant in Tulsa from 1929 to 1935, when he became tax counsel for Mid-Continent Petroleum. In 1942, he organized the company's Income and Excise Tax department.

»

D. O. Barrett has retired as chief mechanical engineer for the Gulf Oil Corporation, Tulsa. Barrett, who has been with Gulf 20 years, was responsible for the introduction of important mechanical operating practices in the oil fields, the latest of which was his peak tension method of rating transmission belts which is now standard practice. Barrett is a Fellow and life member of the ASME.

»

James I. Morris has resigned as instructor in petroleum engineering with the University of Tulsa to become a junior production engineer for The Pure Oil Company at Worland, Wyo.

The *NEW* BOFEC CASING HEAD

showing many Advanced Features

Automatic locking and releasing boll weevil operated by making up or breaking out tubing landing joint.

Arch packer assemblies closing on casings operated independently of casing slip load.

Casing slips heat treated and specially hardened on wickers.

Cross-over flanges with pack-off can be supplied.

All manufactured in accordance with A.P.I. Standards.

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Illustration (left) shows casing slips, boll weevil, arch packer and packing pressure plate stripped from casing head.

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Eugene T. Singer, senior vice president and director of Standard-Vacuum Oil Company, has retired. A specialist in financial problems and foreign exchange, Singer joined the company in 1912 as an accountant in Hong Kong, where he soon became chief accountant. He returned to New York 12 years later, and from 1926 to 1928 he traveled throughout the Far East and Oceania, where he reorganized the accounting procedures of all company offices from Bombay to Tokyo.

Eugene T. Singer

He became treasurer of Standard-Vacuum in 1934. Sent on special assignment to Australia and New Zealand in 1937, he helped organize oil exploration programs covering Papua and New Zealand. In 1939 he was named a director of the company, and was appointed vice president in 1942.

»

R. D. Hanley, manager of the Natural Gas department and a director of Magnolia Petroleum Company, has been elected a vice president. **W. G. Noble,** manager of crude oil purchases and sales for Magnolia, has been made a director of Magnolia Pipe Line Company.

Hanley joined Magnolia Gas Company in 1925 and five years later was transferred to Magnolia Petroleum as chief chemist of the Natural Gas department. In 1938 he was made general superintendent of that department and in April, 1942, he was advanced to manager. He was elected to the board of directors on January 1, 1948.

Noble has been with the organization more than 33 years. He advanced from clerical duties through the Accounting and General Administrative departments.

»

Lake Robertson has resigned as production control engineer for the McCarthy Oil & Gas Corporation at Houston to join the J. S. Abercrombie Company at Bay City, Texas, as production engineer. He is a graduate petroleum engineer from the University of Texas, and a member of AIME and API.

»

Russell J. Cooper has been appointed assistant manager of The Texas Company's Personnel department. He joined Texaco in 1917 as an accounting clerk, and has handled various industrial relations assignments for the company since 1942 except for a period during World War II when he was executive assistant to the industry members of the National War Labor Board.

A. C. Hultgren, traffic manager of Shell Oil Company for territory east of the Rockies since 1935, has retired after 21 years with the company. He is succeeded by **C. H. Wager,** who has been assistant manager of the traffic department since 1940.

»

W. V. Hess has been appointed district geologist for Cities Service Oil Company (Delaware) at Wichita, Kansas. He succeeds **L. G. Morgan,** resigned, who is now with the Stodder-Coleman Oil property.

»

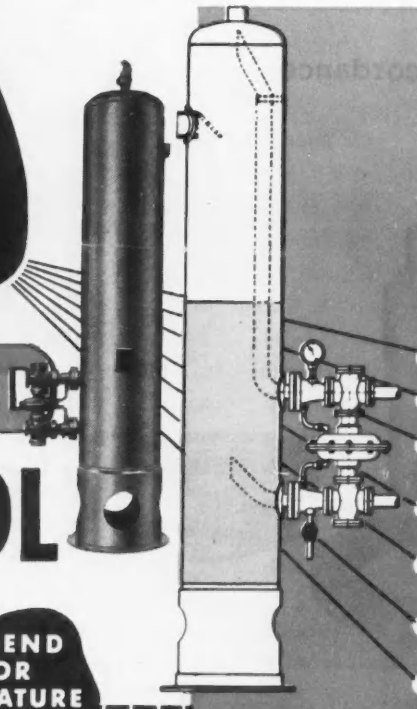
George D. Charlton, formerly with Noranda Oil Company, San Antonio, has been employed by the Midstates Oil Corporation to serve as district geologist for the San Antonio district.

George D. Charlton

Charlton was graduated from Indiana University in June, 1940, with a degree in geology. Before joining the Noranda company, he was employed by Thornton Davis, San Antonio.

LOW COST TROUBLE-FREE GAS AND OIL SEPARATION *with*

BAROID AUTOTROL



AUTOTROL, the floatless separator, provides unsurpassed efficiency in regulating oil and gas flow. Elimination of the float means elimination of separator troubles arising from foaming oil, paraffin coating, and float collapse.

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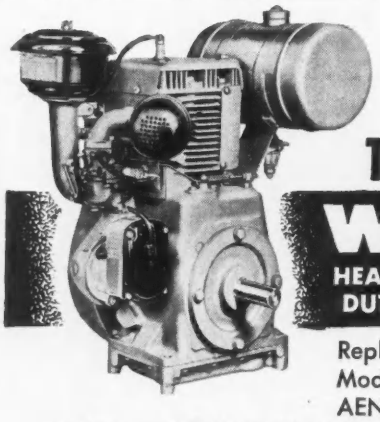
PAA

MEN IN THE INDUSTRY NEWS

VICE PRESIDENT RETIRES—N. H. Perry, right, has retired as vice president in charge of pipe line operations for Gulf Oil Corporation and Gulf Refining Company. Perry was elected a vice president of the company three years ago. Prior to that time, he had served for 27 years as general superintendent of pipe lines. Perry's successor will be J. L. Irvin, left, whose title will be general manager of pipe lines, Houston division. Irvin has been with Gulf since January, 1917, and has served as general superintendent of pipe lines since 1946. Perry began with the company as a fireman at a steam pump station in the old Batson field. He was later an engineer at Lufkin, then chief engineer at Lufkin. He served as a pipe line superintendent for the company in Tampico, Mexico.

Bob Sutton has been named district landman for Cities Service Oil Company in the Permian Basin. He succeeds **J. G. Sauer**, who resigned to become an independent operator.

Charles M. Linehan and **William O. Halliburton** have been named district geologist and district landman, respectively, in the Kewanee Oil Company's new offices at Midland, Texas.



20% Increase in H. P. 15% Decrease in weight That's the *New* MODEL AEN

WISCONSIN HEAVY-DUTY *Air-Cooled* ENGINE!

Replacing the universally popular Wisconsin Model AEH Air-Cooled Engine, the new Model AEN turns up 7.5 H.P. at 3,000 R.P.M. as against 6.1 H.P. at 3,200 R.P.M. delivered by the engine it replaces. Weight: 110 lbs., as against 130 lbs. for the AEH.

All this has been accomplished without sacrificing heavy-duty crankshaft capacity or any of the traditional Wisconsin features such as: Tapered roller bearings at *both* ends of the drop-forged crankshaft; oil pump and spray lubrication; weather-sealed high tension outside magneto with impulse coupling for quick starting and dependable ignition in any climate, in any weather; flywheel-fan air-cooling — extremely efficient at all temperatures from sub-zero to 140°F.

The Model AEN represents a major achievement in the design and construction of a light weight heavy-duty power unit for all-purpose power applications. Write for Bulletin S-109.

The Wisconsin line includes 4-cycle single cylinder, 2- and 4-cylinder models in a complete power range from 2 to 30 H.P.

WISCONSIN MOTOR Corporation
MILWAUKEE 14, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 Atlas Building, Tulsa, Oklahoma
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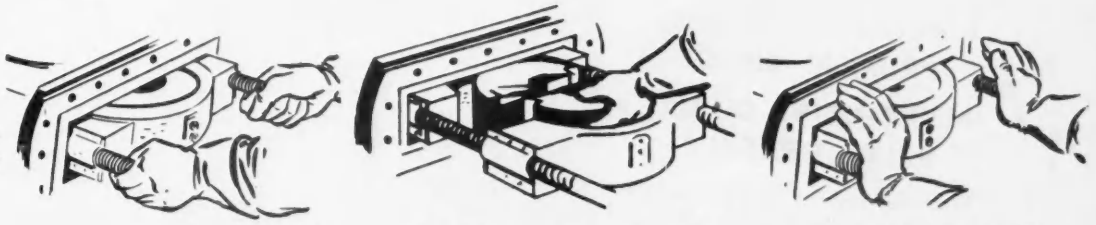
Oil field distributors for Wisconsin Engines and all types of utility units.

Two Shaffer Type 46 Single Cellar Control Gates with a Shaffer Combination Rotating Blow-Out Preventer and Stripper. (top).

Since the very first gate built many years ago, Shaffer Cellar Control Gates have *always* featured maximum speed and simplicity in changing rams. Simply remove *one* end cover and the *complete* ram assembly is readily accessible for changing the rams. Replace the end cover—and the job is done!

That's something to remember—*from the very first Shaffer Cellar Control Gate ever built*, Shaffer owners have ALWAYS had the advantage of fast, easy ram changes—and this feature is just one of *many* advantages incorporated into Shaffer Gates. So before you buy *any* control gate, be sure to check *all* of the important ways Shaffer Cellar Control Gates—both Single and Double types—bring you years-ahead safety, versatility, installation simplicity and compactness. *Only Shaffer—pioneer of modern control gate equipment—gives such outstanding leadership in* EVERY *vital control gate feature!*

FAST, EASY RAM CHANGE has always been a Shaffer feature!



1 To change Shaffer rams, simply remove one end cover . . .

2 . . . and the *complete* ram assembly—not just *half* of it — is readily accessible.

3 Lift out old rams and install new rams to fit requirements . . .

4 . . . slide the assembly into the body, replace the one end cover . . . and the job is done!

. . . and there are many other unique Shaffer advantages!

In every important feature essential to maximum safety and efficiency, Shaffer Cellar Control Gates provide unique advantages — vital advantages that save money, save space and assure maximum safety in cellar control gate protection. Other examples of Shaffer advantages include . . .

THREE-WAY SPACE SAVING: All Shaffer Cellar Control Gates have long been noted for their unusually small overall *height* as well as their amazing compactness in *length* and *width*. This three-way cellar-saving compactness not only minimizes costly cellar depth requirements and permits lower rig floors, but, in addition, provides more *all-around* space in the cellar and makes possible cleaner, more compact, clutter-free rig hook-ups.

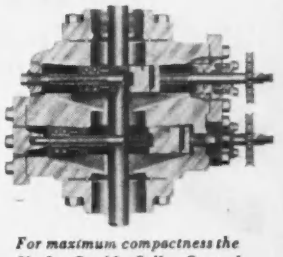
WIDE CHOICE OF POWER DRIVES: Shaffer Gates can be operated with virtually any type or power—air, steam or electric—plus the added safety of manual standby. This assures maximum versatility, maximum protection at all times!

FOOL-PROOF, NON-CREEPING RAMS: *Positive* mechanical screw feed not only provides quick fool-proof ram operation, but also firmly holds Shaffer rams in whatever position they are set without need for auxiliary locking devices or extra operations of any kind!

SELF-CLEANING DRAINAGE: The entire bottom of Shaffer Gates is sharply sloped toward the well so that any mud and sand that gets into the gate quickly drains back out again. The rams travel on high, narrow guide ribs that afford adequate support, yet prevent mud and sand accumulation from interfering with free ram operation.

PRESSURE-BACKED CLOSING: Shaffer Gates are so designed that well pressure flows up *behind* the rams to assist in the closing operation. After the rams are closed, well pressure below the rams assists in sealing them even tighter as well pressure increases. The higher the well pressure, the tighter Shaffer rams *seal—automatically!*

. . . AND MANY OTHER ADVANTAGES: These are only highlights in the complete story of Shaffer superiority. Send for full information on the multiple ways Shaffer Cellar Control Gates assure greater safety, maximum operating efficiency, simpler and more compact installations!



For maximum compactness the Shaffer Double Cellar Control Gate is ideal. It provides two gates unitized into one body.

Send for your free copy of the new Shaffer Catalog!

See pages 3843 to 3894 of your Composite Catalog for additional information on Shaffer Products.

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EXPORT SALES OFFICE: Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

Transfers:

Bryan E. Mitchell, Jr., has been transferred from Stanolind Oil and Gas Company's Turtle Bay area office at Liberty, Texas, to the Tulsa general offices as a petroleum engineer in the Production department. In the Exploration department, **John H. Osborne, Jr.,** has been placed in charge of a gravity meter party at Poplarville, Miss.; **Thomas J. McMillan,** gravity meter party chief, has been transferred from Torrington, Wyo., to Laurel, Miss.; **Everett L. Hinds** was transferred from Oklahoma City and placed in charge of a core drill party at Dodge City, Kansas; **Virgil T. Brown,** driller's supervisor, was transferred from Beloit, Kansas, to Belleville, Kansas, in charge of a core drill party; and **Clyde L. Hays,** gravity meter party chief at Freeport, Texas, has been transferred to Laredo, Texas, in charge of a party there . . . **J. T. Bradley** and **J. W. Schriever,** Warren Petroleum Corporation, have been transferred from the Tulsa headquarters to Madison, Wis., as district sales manager and district sales representative, respectively . . . **J. M. (Jack) Miller** has replaced **G. B. Kitchel,** resigned, as drilling equipment engineer in charge of the Drilling Equipment division of Humble Oil & Refining Company. **W. H. Stephens,** district chief clerk, Houston construction district, has been transferred to the Katy gas cycling plant construction district. He replaced **I. M. Howell,** who was promoted to assistant chief clerk in the Gas Construction division in Houston. **William J. Allen,** district clerk, Imogene district, was promoted to district chief clerk of the Flour Bluff Gas Plant Construction district. **Bert R. Williamson** has been named marine equipment material pusher of the Marine Equipment division. **J. J. Martin** was transferred from the New Orleans marine construction district to the marine equipment division, Houston office, as chief clerk. **H. L. Landua** and **G. F. Abendroth** have been transferred to the petroleum engineering division, Houston, as supervising petroleum engineers. Landua formerly was district petroleum engineer of the Odessa District, and Abendroth was district petroleum engineer of the Avery Island District. **A. J. Shaw,** Means district petroleum engineer, was transferred to the Odessa district to replace Landua, and **V. E. Skalnik,** petroleum engineer at Means, was promoted to Shaw's previous position. **A. M. Nixon,** gas plant repairman, first class, has been transferred from Katy gas cycling plant to the North Crowley district as mechanical supervisor . . . **C. B. Hussey** of Odessa, has been transferred to the Houston executive department of Gulf Oil Corporation as division petroleum engineer. **Neal B. Martin,** district chief clerk at Shreveport, has been transferred to the Houston district Production department as assistant to the superintendent of production. **T. B. Young,** petroleum engineer at Laurel, Miss., has transferred to Houston as assistant chief petroleum engineer. **C. F. Russ,** assistant to the superintendent of production in Houston, has been transferred to the Houston Executive department as division field examiner. **Herb Officer,** Gulf scout, has been transferred from Oklahoma City to Casper, Wyo., and has been succeeded by **Dick O'Connel** from Seminole, Okla.

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The Sure Sign of Dependability
• UNMATCHED SELF-PRIMING SPEED!
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Whenever you see a CMC centrifugal pump on duty you see maximum dependability. Advanced centrifugal design and dual jet construction mean peak performance at all times. Extra air handling ability permits dependable performance when ordinary centrifugal pumps become air bound and lose prime.
CMC Pumps are the handiest in the field—the last word in simple, rugged, fool-proof construction! Available in sizes from 1½" to 10" —from 3,000 to 200,000 gallons per hour. Write for Bulletin IP-147.
CMC DUAL PRIME MODEL 21 ⟶
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F. R. Yost

F. R. Yost has been named to the new post of manager of the Producing department of Stanolind Oil and Gas Company. Yost started in the oil business as a roughneck with the Yount-Lee Oil Company in 1934. The following year, when most of the Yount-Lee properties were purchased by Stanolind, he became a roughneck for Stanolind in the High Island field in Texas.

After that, Yost worked as driller, tool pusher and field superintendent. In 1943, he was named head of industrial relations for the Texas-Louisiana Gulf Coast division in Houston. Later he became district production superintendent for Kansas, and in 1945 he was made drilling superintendent in the Producing department. Since January 1, 1947, he has been operating superintendent.

Manhattan's New Rotary Hose and Built-in Coupling . . . are earning the Tool Pusher's Preference

RAY-MAN ROTARY HOSE

A new conception of rotary hose construction gives RAY-MAN the super-flexible qualities demonstrated by the loose, supple coils illustrated here. Tool pushers make up Ray-Man Rotary Hose to swivel and stand pipe easier and quicker than ever before. It's also easier to transport from hole to hole. The hose suffers less stress and damage—lasts longer.

TYPE E BUILT-IN COUPLING

The new, streamlined coupling on Ray-Man Rotary Hose also contributes greatly to easier handling and freedom from accident. It's a lighter weight, full-flow coupling with no projecting flanges. The "Lip-Lok" Pressure Sealing feature is a new safeguard against costly leaks and blow-outs.

Made in 5,000 lb. test pressure for Ray-Man Rotary Hose and 4,000 lb. test pressure for Paranite Brand.

SIX MAJOR IMPROVEMENTS IN CONSTRUCTION . . . make this combination your best buy.

1. Is extremely flexible
2. Holds steady in the derrick—resists pulsation under pressure
3. Lasts longer because of balanced, engineered construction
4. Handles easier in moving from location to location with less likelihood of damage
5. Has G. O. P. Flexlastics tube for all methods of drilling, including drilling-in with oil or oil-base mud
6. Has new Built-In Coupling featuring "Lip-Lok" leakproof seal

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Perfect Answer for Leak Proof Production Line Connections

RECTORSEAL #1

Ask the man in the field . . . he'll tell you that RECTORSEAL #1 is the answer! It's positive . . . no worries about leaks . . . no galling.

10 years of every kind of test in the field and in the laboratory stand back of your confidence that RECTORSEAL #1 means "no leaks."

Apply easily with brush or swab to each joint of pipe and you'll see for yourself RECTORSEAL is LEAK-PROOF!

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RECTOR WELL EQUIPMENT CO., INC.

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MAKING THE OIL INDUSTRY SAFER

PETROLEUM ENGINEERS
CABLE & STINE
WICHITA FALLS, TEXAS

EXPERIENCED PRACTICAL AND TECHNICAL CONSULTING PRODUCTION ENGINEERING SERVICE

•

SPECIALIZING in MODERN SECONDARY RECOVERY

DEATHS

Ross Shaw Sterling, 74, of Houston, chairman of the board of Sterling Oil and Refining Corporation and president of Royalty Properties, died March 25 in Fort Worth. Sterling, who was governor of Texas from January 20, 1931 until January 17, 1933, was instrumental in establishment of laws designed to permit the Texas Railway Commission to limit oil production by proration.

Ross Sterling

He began his oil career by buying two flowing wells in the Humble, Texas, field, nucleus of Humble Oil & Refining Company, which, together with W. S. Farrish, W. W. Fondren, Harry C. Wiess and R. L. Blaffer, he organized in 1917. In 1925, he retired as chairman of the board and sold most of his interests in the company.

Aside from oil, Sterling was active in other business fields. He built the skyscraper Sterling and Shell buildings in Houston, was publisher of a Houston newspaper, founded Houston's first commercial radio station, held a controlling interest in a Houston bank, and built and operated a South Texas railroad. He led in the development of Houston's port, and served as chairman of the Port Commission for several years. He was a founder of the Baytown, Texas, oil and industrial development.

Sterling served as chairman of the Texas Highway Commission before he became governor of the state. Noted for his philanthropies, he was given the Rotary Club award as an outstanding citizen in 1925, and two years ago was awarded the Sons of the American Revolution annual medal for citizenship.

During the depression years, Sterling lost most of his holdings, and he started to regain his financial position when he was 58 years old. With a $100 Liberty Bond saved by his wife, he paid the expenses of chartering the Sterling Oil and Refining Corporation. After several years of struggle, the corporation became successful, and now has extensive holdings. For the second time in his life, Sterling amassed a great fortune. He served as president of the company until 1946, when he became chairman of the board. He was succeeded as president by his son, Walter.

Sterling was a member of API and the Mid-Continent Oil and Gas Association.

»

R. C. Patterson, 62, pioneer Southern California oil man, died at Glendale April 4. He was supervisor in Southern California for 23 years in the U. S. Geological Survey before he became an executive of Belridge Oil Company. At the time of his death he was a consulting petroleum engineer. Patterson was a member of AIME, Petroleum Production Pioneers and API.

H. M. Amsler, 51, Houston, vice president of the Richrock Royalty Company, died April 3 at Key West, Fla. Amsler was a director of Tennessee Gas Transmission Company and Sterling Oil and Refining Company.

»

Ed Peterson, 73, independent oil operator and a participant in the Spindletop boom, died March 10 at Wichita Falls, Texas. He started in the oil business in Pennsylvania. He had resided in Wichita Falls since 1917, moving there shortly after the opening of the Burkburnett field.

»

T. K. Knox, 52, past president of the Dallas Geological Society and a former vice president and chief geologist of Republic Natural Gas Company, died March 10 in Dallas.

»

L. H. Attwell, former comptroller of the Humble Oil & Refining Company, died March 15 in Houston. Attwell was comptroller for Humble from 1919 until 1940, when he retired. He was receiver and auditor of the Texas and Brazos Valley railroad for 11 years before joining Humble.

»

Frank Wallace, 56, vice president in charge of drilling for Woods Oil Company, Tulsa, died March 22. Before joining Woods Oil Company a year ago, he had been superintendent of drilling for Wilcox Oil Company for about 20 years.

»

Forest B. Smith, former chief landman for Humble Oil & Refining Company in Houston, died April 4 at Greenfield, Ill.

»

Dudley D. Morgan, independent Oklahoma oil man, died March 19 in Tulsa. He was co-discoverer of the Davenport and Earlsboro, Okla., oil pools, and also was a successful operator in Kansas. He attended Harvard University and was a veteran of World War I, in which he served as an ensign.

»

Frank D. Bruce, 81, retired field superintendent of Oklahoma Natural Gas Company, died March 16 in Tulsa. He had lived in Tulsa since 1909 and before joining ONG had served as field superintendent for the Savoy Oil Company.

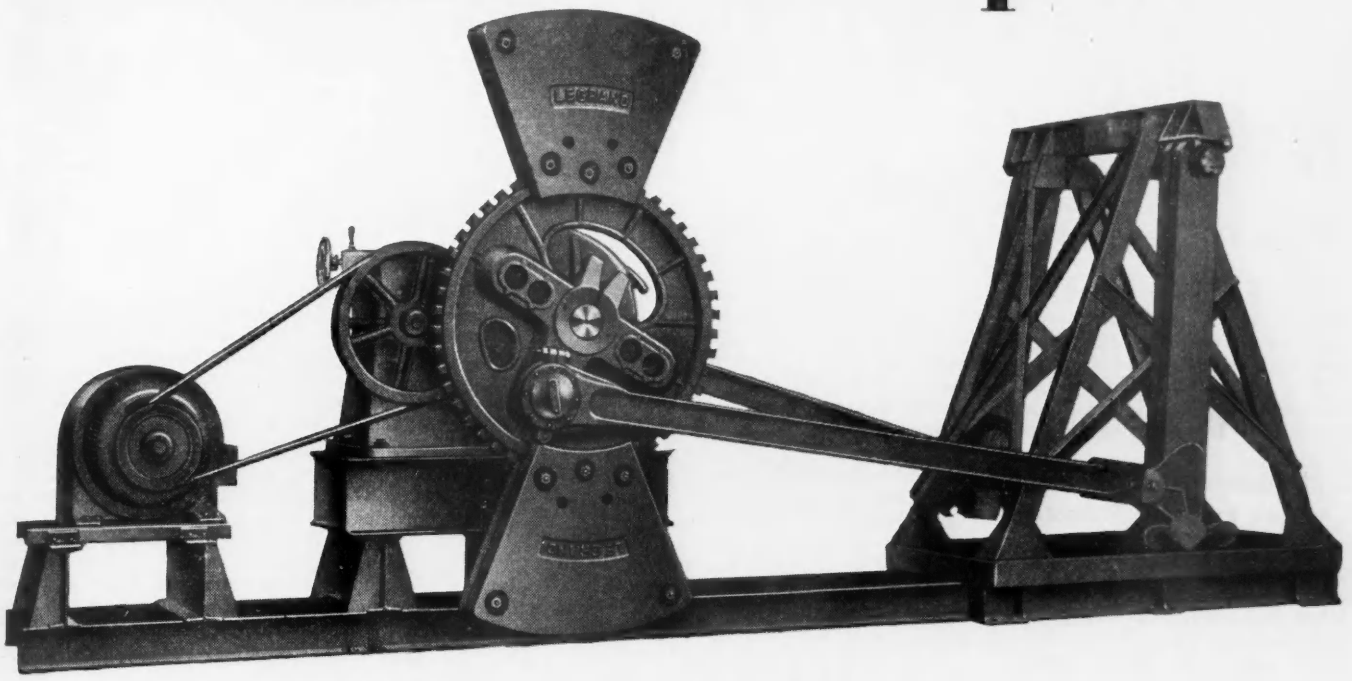
»

F. E. Webb, Oklahoma oil operator, died March 28 at Wagoner, Okla. Webb, who homesteaded in Oklahoma in 1901, was credited with discovering a number of oil fields in Oklahoma and Texas and also operated in Illinois.

»

Frank H. Stohr, 47, general manager of the Allis-Chalmers Manufacturing Company's Norwood (Ohio) Works, died March 29. Before joining Allis-Chalmers, Stohr had been executive vice president and director of the Elliott Company, Jeannette, Penn.

LE GRAND
Pendulum Pumpers



15/30 Pendulum Pumper

GENERAL SPECIFICATION

Max. out of balance load each pendulum	LBS.	4,900 @ 20″ Stroke 3,266 @ 30″ Stroke
Crank Strokes - -	INS.	18 & 27
Pull Line Strokes - -	INS.	20 & 30
Reduction Gear Peak Torque	LB. INS.	98,000
Reduction Gear Ratio -		30 : 1
A.P.I. Horse Power - -		13.6 at 14 S.P.M.
A.P.I. Horse Power - -		19.8 at 20 S.P.M.
Input Pulley P.C.D. - -	INS.	24½
Motor Pulley P.C.D. - -	INS.	10.53 to give 14 S.P.M.
Motor Pulley P.C.D. - -	INS.	15.74 to give 20 S.P.M.
Vee Ropes required at 14 S.P.M.		5 'C' 158 ins. long
Vee Ropes required at 20 S.P.M.		5 'C' 168 ins. long
Pulley Centres - - -	INS.	48
Counterbalance - -	CRANK	1
Max, Balance effect of counterweights	LBS.	10,100 @ 20″ Stroke 6,733 @ 30″ Stroke

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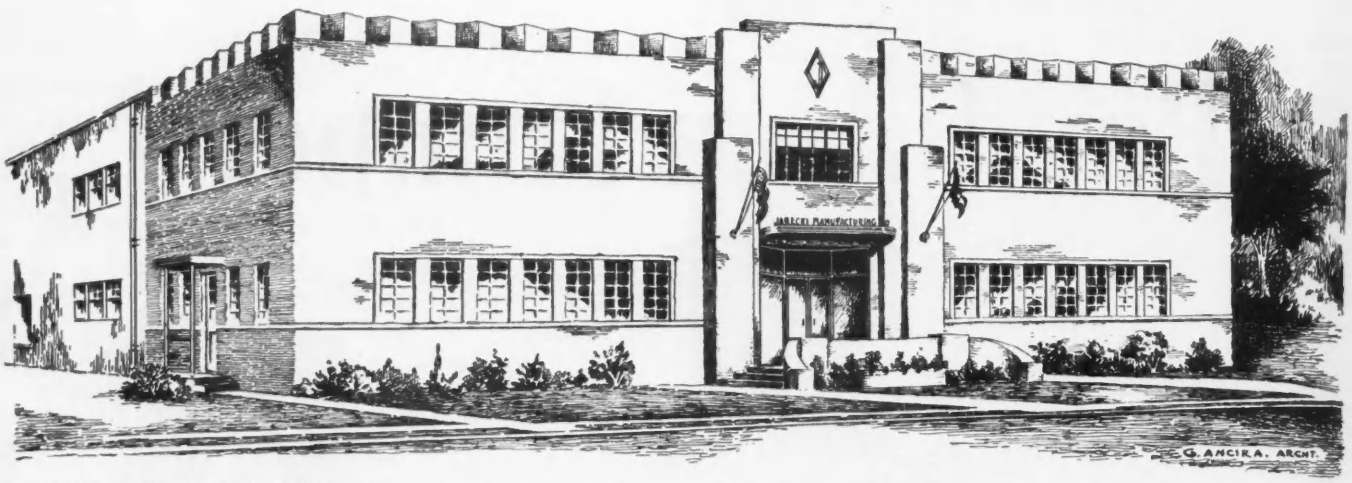
OILFIELD EQUIPMENT MANUFACTURERS & FOUNDERS

EQUIPMENT AND SERVICE SUPPLIERS' NOTES



JARECKI OFFICE BUILDING—The Jarecki Manufacturing Company has begun construction of its new office building at Houston to house the company's Oil Field Supply division. The two-story structure, which is located in the Industrial and Warehouse district, will have structural steel frame with hollow tile walls faced with white brick and limestone trim. It will have 110-foot frontage on the 6300 block of Navigation Boulevard, in front of the warehouse now located on this property. The building will have fluorescent lighting, acoustical ceilings and walls, tile floors, inter-communication telephone system, wired music, and air conditioning. A restaurant, sun decks, and recreational area will be provided. There will be capacity for 150 employes. G. Ancira, architect, Walter P. Moore, structural engineer, and Raymond L. Jenkins, mechanical engineer, planned the building and will supervise its erection. It is being constructed by Walter M. Rainey Construction Company.

Schlumberger Announces Division Changes, Executive Promotions

Roger Henquet, former vice president and general manager, was named executive vice president of Schlumberger Well Surveying Corporation and D. C. McCann was promoted to vice president and manager of operations.

McCann will be assisted in his Houston headquarters by J. A. Bodin, R. Legeron and E. F. Stratton.

The Kansas, Oklahoma, North Central Texas and Permian Basin divisions of Schlumberger have been consolidated into one division with headquarters in Tulsa. The Tulsa headquarters will be under the management of R. G. Hamilton. R. D. Ford, former public relations manager for Schlumberger, has been transferred from Houston to Tulsa to serve as assistant manager of the enlarged Tulsa division.

Under direction of the Tulsa division, L. G. Chombart will serve as manager of the Kansas division, L. A. Puzin as manager of the Oklahoma division, R. I. Seale as manager of the North Central Texas division and A. Morazzani as manager of the Permian Basin division.

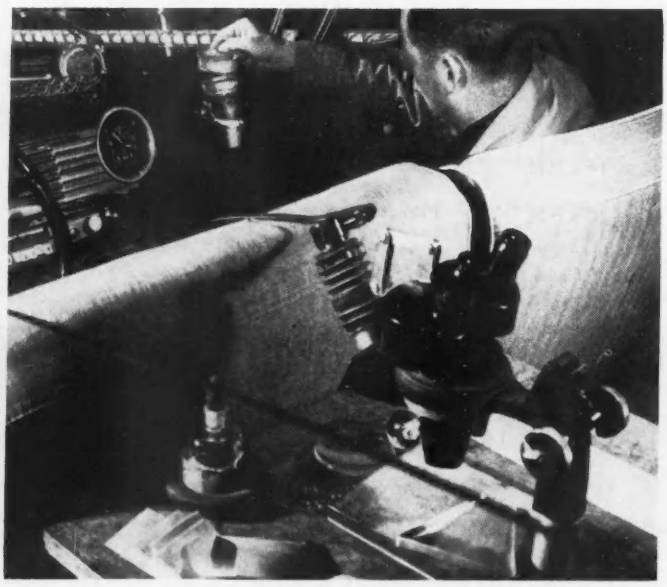
W. R. Mills, former manager of the Oklahoma branch, will transfer to Houston to serve as assistant to R. R. Rieke, manager of the Gulf Coast area.

Black, Sivalls & Bryson Transfers Three, Adds to Engineering Staff

Joe Beggs, who for 12 years has managed the branch store at McPherson, Kansas, for Black, Sivalls & Bryson, Inc., has been transferred to the managership of the Ellinwood, Kansas, branch. Winston O. Shook, from the Hays, Kansas, branch is now branch manager at McPherson. M. F. (Mike) Barnes, formerly of Ellinwood, has been transferred to the sales division and will be stationed at the regional offices at Great Bend.

Charles W. Stevens has been transferred from Odessa, Texas, to San Angelo, where he will be sales representative with headquarters at 2320 West Avenue J.

Olin L. Medley, a graduate of the University of Oklahoma, has joined Black, Sivalls & Bryson's sales engineering staff at Shreveport.

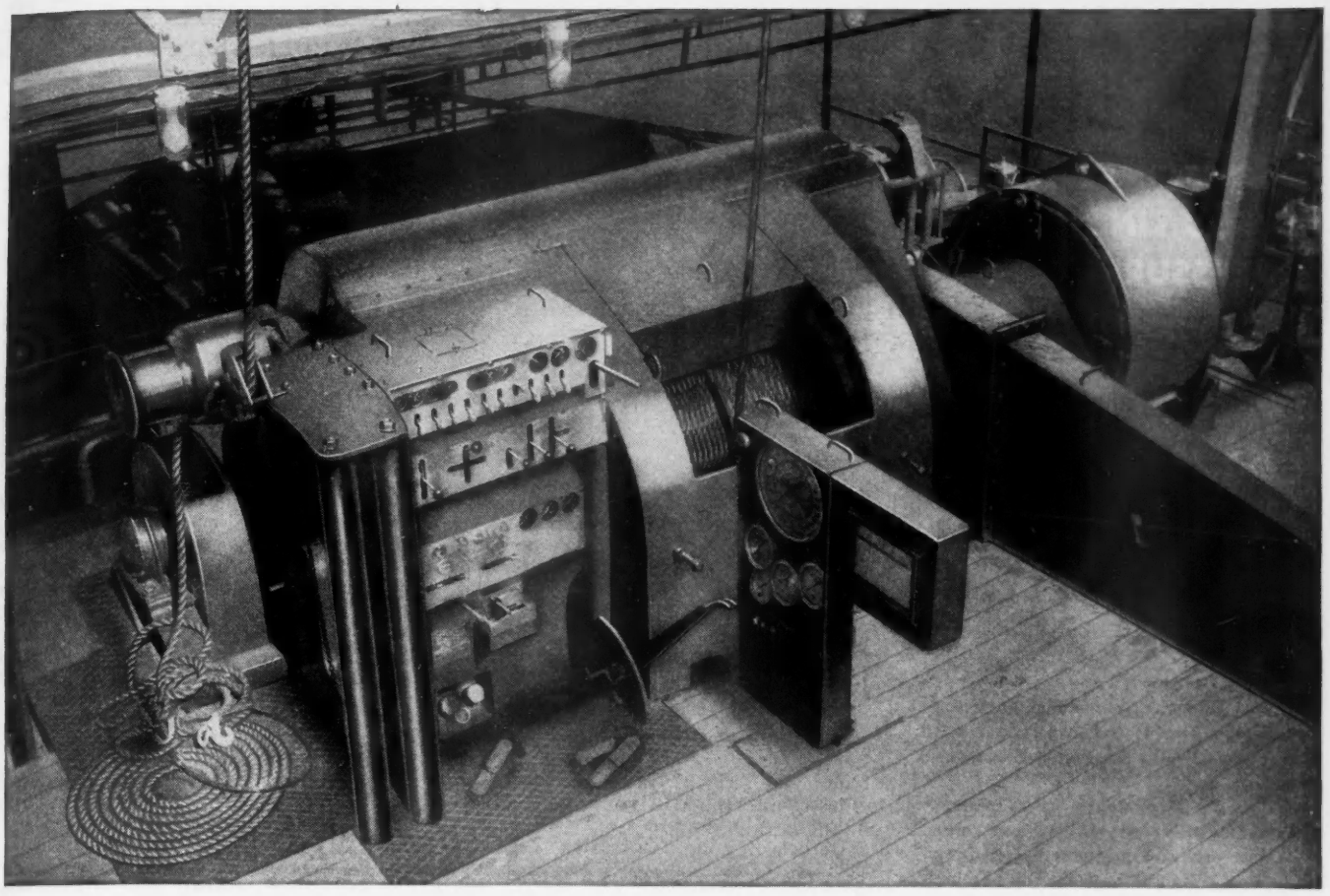


LAB ON WHEELS—Sub-strata earth samples are analyzed at the well in this mobile laboratory, a converted passenger car outfitted with all essential geological instruments and equipment by J. M. Huber Corporation, Borger, Texas. Oil well cuttings are dried with heat furnished by the car heater, and the microscope plugs into a special dashboard connection. An altimeter, usually seen in airplanes, checks elevations. Cutting data for succeeding depths are recorded on strip log.

Drilling Company Organized In Houston by J. U. Teague

J. U. (Jim) Teague has organized the Columbia Drilling Company, with headquarters in Houston. This represents a change in name from Columbia Well Servicing Company, a change made because the company was wholly engaged in drilling operations. Teague, a graduate of Rice Institute, served Humble Oil & Refining Company as petroleum engineer from 1930 to 1940, when he became general superintendent for Hogg Oil Company. He became president of Columbia Well Servicing Company when it was organized in July, 1947, and now is president of Columbia Drilling Company.

J. U. Teague



Speed Up Round Trips with Frictionless Magnetic Braking

The Dynamatic Drawworks Brake is completely magnetic; no friction or wear; no brake blocks or bands to replace. Proved by outstanding records in all fields, including off-shore operations.

- **Simple as a light circuit.**
- **Precision control from driller's position.**
- **Operates on ordinary light plant current.**
- **High torque at low speeds.**
- **Sets slips on heaviest strings without friction brake.**
- **Readily applied to all rigs—large or small. Can be installed in the field.**

Dynamatic Drawworks Brakes are available from drawworks manufacturers and their distributors. Write for illustrated literature.

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DRAWWORKS BRAKES

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EATON MANUFACTURING COMPANY, CLEVELAND, OHIO

HOW TO STOP THE HIGH COST OF HIGH MUD LINE PRESSURES

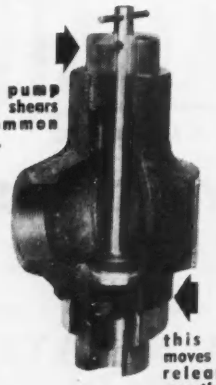
CAMERON
SHEAR-RELIEF
VALVE

With Cameron Shear-Relief Valves on your rigs, high mud line pressures will cost you only the price of one common nail.

Cameron Shear-Relief Valves protect pumps, manifolds, drilling hose, etc., against excessive pressures by releasing the flow of fluid through the valve outlet. A common nail shears when pump pressure against the valve piston reaches the shear stress of the nail.

The sheared nail is the only damaged part, and the valve is easily reset with another nail by any member of the crew, using directions on the valve nameplate for nail sizes and the pressure at which each size shears.

Write for complete details or see your Composite Catalog.



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Export: 74 Trinity Place, New York, N. Y.

OSTER SALES CLINIC—Shown are company officials and members of the sales staff who attended the four-day sales clinic of The Oster Manufacturing Company. Roger Tewksbury, president, opened the clinic with an appraisal of general business conditions in which the manufacture of orders will govern the manufacture of products. Art Gould, vice president, presented Oster's 1949 sales plan, arranged to meet the conditions expected in the transition from a sellers' to a buyers' market.

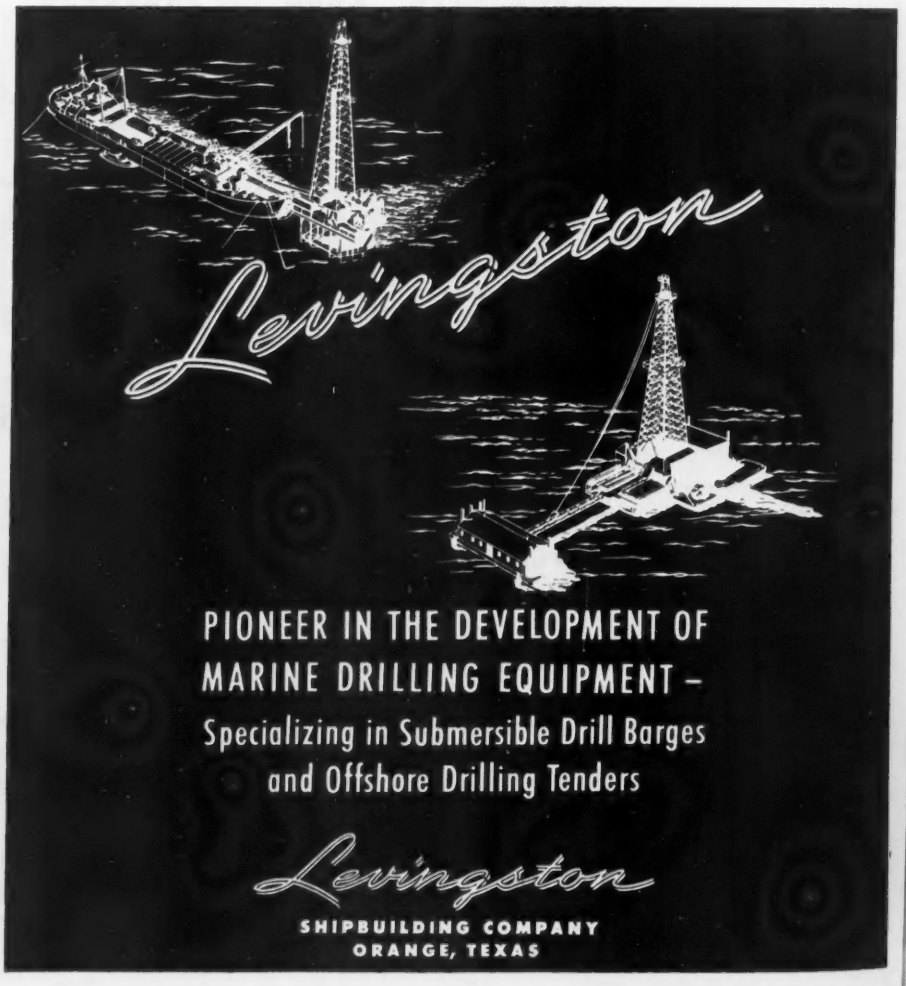
Cummins Diesel Sales Engineer Is Named to Serve Dallas Area

Richard Keast has been appointed sales engineer for Cummins Sales & Service, Inc., in the Dallas area. He will handle the sales of Cummins Diesel Engines from the Dallas office in the Magnolia Building.

Before joining Cummins Sales & Service, Keast was with Autocar Sales & Service of Dallas, and before that was manufacturer's agent for automotive parts. He was a sales engineer at the Allis-Chalmers factory in Dallas and was a member of the production and drilling division of the Rio Bravo Oil Company of Houston.

Hinderliter Sales Manager Named

John S. Chick has been appointed manager of production equipment sales of the Hinderliter Tool Company division, H. K. Porter Company, Tulsa. Chick, who was formerly with The Carter Oil Company and Baker Oil Tools, Inc., has had 20 years experience in production and in handling producing equipment.



Praising SERVICE *and* SAVINGS

Hundreds of policyholders of the Texas Employers' Insurance Association, many of whom have been policyholders for more than a quarter of a century, write the Association letters praising its service and savings. Here are excerpts from just two of these letters:

"This will acknowledge receipt of your check in the amount of $7,204.92 which, with our cash discount makes a total saving for last year's premiums of $10,958.21 . . . Your method of handling our claims, investigating each claim thoroughly and reporting to us your recommendations for settlement, is certainly a good way for a contractor to improve his compensation position. Your engineering department has certainly done a nice job on our safety work."

"We thank you for the nice dividend check given us . . . While we appreciate this substantial saving on our Workmen's Compensation Insurance, we really appreciate more your promptness and fair dealings in handling our claims . . . We also wish to pay tribute to your Safety Engineering Service whose accident prevention work towards our employees has been most competent and intelligent."

Do you get such service and savings from your Workmen's Compensation Insurance carrier? If not, why not? Thousands of Texas employers are enjoying this service and participating in these savings, which have already amounted to over $23,000,000.

COMPLETE SERVICE

The Texas Employers' Insurance Association maintains facilities whereby employers of labor in Texas can secure complete and highly specialized Workmen's Compensation Insurance Service, including:

- Nineteen district service offices.
- Proved financial responsibility.
- Qualified rating and underwriting "know-how."
- Prompt handling of claims.
- Texas' largest insurance safety engineering organization.
- Insurance at cost to Texas employers.

TEXAS EMPLOYERS INSURANCE ASSOCIATION

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HOMER R. MITCHELL, *Chairman of the Board* A. F. ALLEN, *President*

763-Mile Trip To Mexico City

Roadability of modern, rubber-tired earthmoving equipment was demonstrated when a LeTourneau Tourapull-Scraper was driven from Laredo, Texas, to Mexico City, a distance of 763 miles, in 46 hours.

LeTourneau's Mexico distributor, Construccion y Maquinaria, S. A., took delivery of the machine on the U. S. side of the border at Laredo, because railroad restrictions prohibited rail shipment to its destination. Rather than wait several weeks for rail permits, it was decided to drive the machine over the highways to Mexico City. Accompanied by Dover (Doc) Fouts, export sales engineer, the distributor's representative made the first leg of the journey from Laredo to Monterrey, a distance of 146 miles, in eight hours.

The 20,700-pound earthmoving tool averaged 16.6 miles per hour, and consumed 154 gallons of diesel fuel.

Andre S. Rubin Is Appointed Marlow Pumps Sales Manager

Andre S. Rubin

Andre S. Rubin, Jr., has been appointed sales manager of Marlow Pumps, Ridgewood, N. J. Rubin joined Marlow Pumps in 1942 as assistant to the late A. S. Marlow, Sr., founder of the company.

After graduation in 1934 from Rensselaer Polytechnic Institute, Rubin was associated with Continental Oil Company. He was in the marketing division of that company until 1942.

New District Sales Manager Is Named by Peerless Pump Division

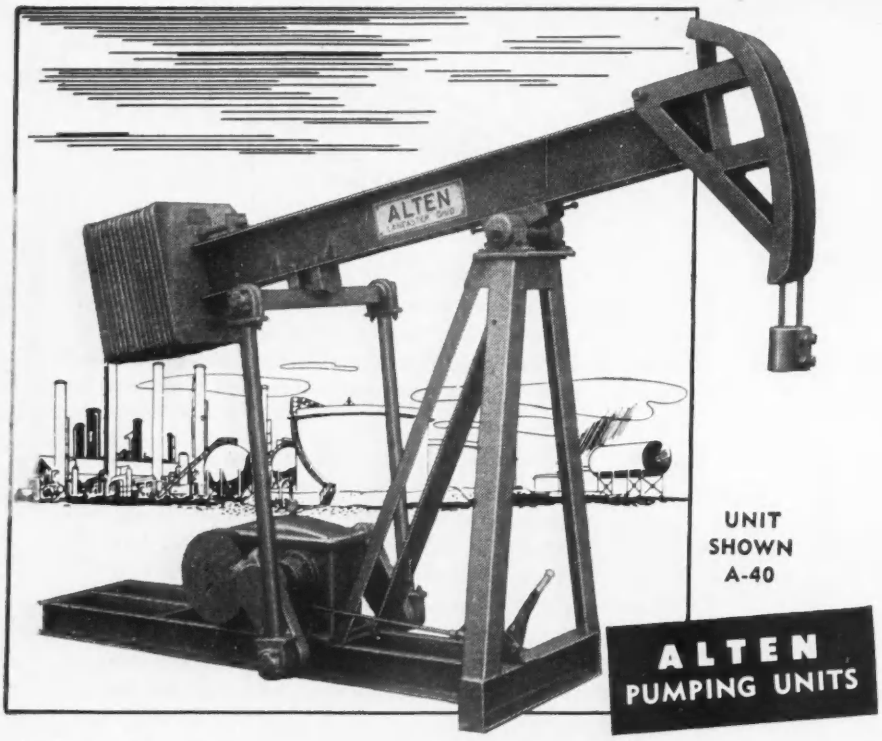
J. W. L. Stone

J. W. L. Stone, Peerless Pump Division, Food Machinery and Chemical Corporation, has been appointed district manager of a new Peerless sales office, with headquarters at 4330 Leavenworth Street, Omaha, Neb. His territory will include North and South Dakota, Montana, Minnesota, Nebraska, Kansas, Colorado and portions of Wyoming, Missouri, Wisconsin and Iowa. Stone was formerly a field engineer in the southwest district.

As district manager, Stone will supervise the sales of both the horizontal and vertical lines and other pumps of the company's manufacture.

Hauco Supply Appointed Spudder Distributor for Bucyrus-Erie

Hauco Supply Company, Greensburg, Penn., was appointed distributor for the spudders of Bucyrus-Erie Company, South Milwaukee, Wis. The firm will handle the Bucyrus-Erie 24-L, 28-L, 36-L, and 48-L spudders. Hauco Supply Company's territory will include Bedford, Blair, Clearfield, Indiana, Armstrong, Butler and Mercer counties in Pennsylvania; and the counties of Hancock, Brooke, Ohio, and Marshall in West Virginia.



UNIT SHOWN A-40

ALTEN PUMPING UNITS

Check 'em for cost

By cost, we mean more than selling price. Compare Alten Units with any others—on economical production, upkeep, freedom from break-downs, long life. Many oil men who have made such cost comparisons rate Alten tops. Use them for money-saving operation.

Also Casing Heads, Stuffing Boxes, Stop Cocks and other production items.

A-40 FEATURES

★Rigid, all-welded steel Samson Post, Frame and Beam. Structural rating: 4,000 lbs.

★Quality Gear Reducer. Hardened alloy gears and pinions. Roller-bearing equipped. Double reduction ratio: 33.2:1. Torque rating: 17,500 in. lbs.

★Adjustable stroke length: 17" to 23".

★Wrist Pin and Equalizer has double-row, spherical, self-aligning roller bearings.

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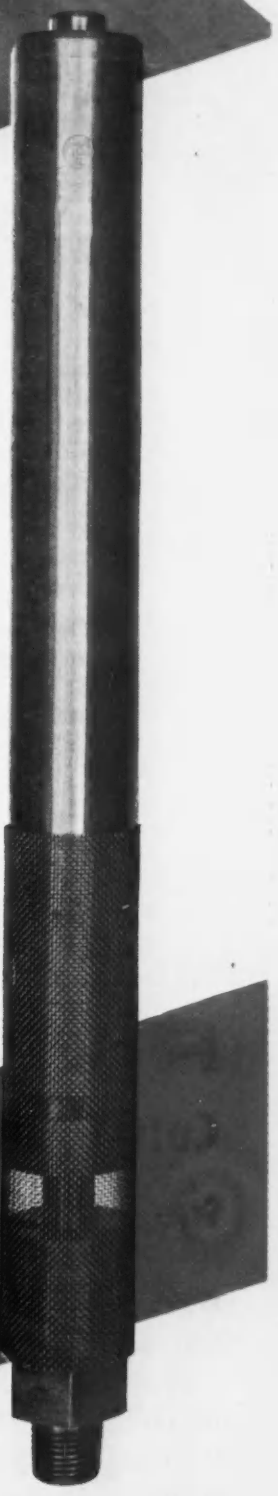
FOUNDRY & MACHINE WORKS, INC.

Lancaster, Ohio

Established 1889

Ask for Name of Nearest Dealer

FAST LESSONS IN EFFICIENCY



THE *NEW* GOT-OLSCO "O-CF" VALVE IS MAKING GAS LIFT HISTORY *WHEREVER IT'S USED*

Wherever they've been installed . . . in high volume wells lifting great quantities of fluid or in low productivity wells where they're used strictly as unloading valves above a single intermittent-type "O" Valve . . . GOT OLSCO "O-CF" Valves have been acclaimed for high efficiency, dependability and economy.

Combining the principles of *pressure differential* and *pressure charged* valves, these new valves are controlled through a combination of injection pressure *and* tubing back pressure. This combination of principles results in completely automatic valves that open and close in conformance with fluctuating conditions in the well. It is impossible to "flood" them . . . a rise in the fluid level automatically opens a higher valve; a drop in the fluid level opens a lower valve.

Get the full story on these high-efficiency "O-CF" Valves from your GOT-OLSCO representative or from our Houston headquarters. You'll like the savings they make in your gas lift operations.

FULL USE OF AVAILABLE INJECTION PRESSURE

In any one string, all "O-CF" Valves are charged to the same pressure, permitting a *constant* injection pressure that automatically works down to the most efficient working level. This eliminates the necessity for decreasing injection pressure while working down the hole and permits *full use of available pressures right down to the lowest valve in the string.* In most instances, an ordinary choke, for controlling injection gas volumes, is the only surface control required.

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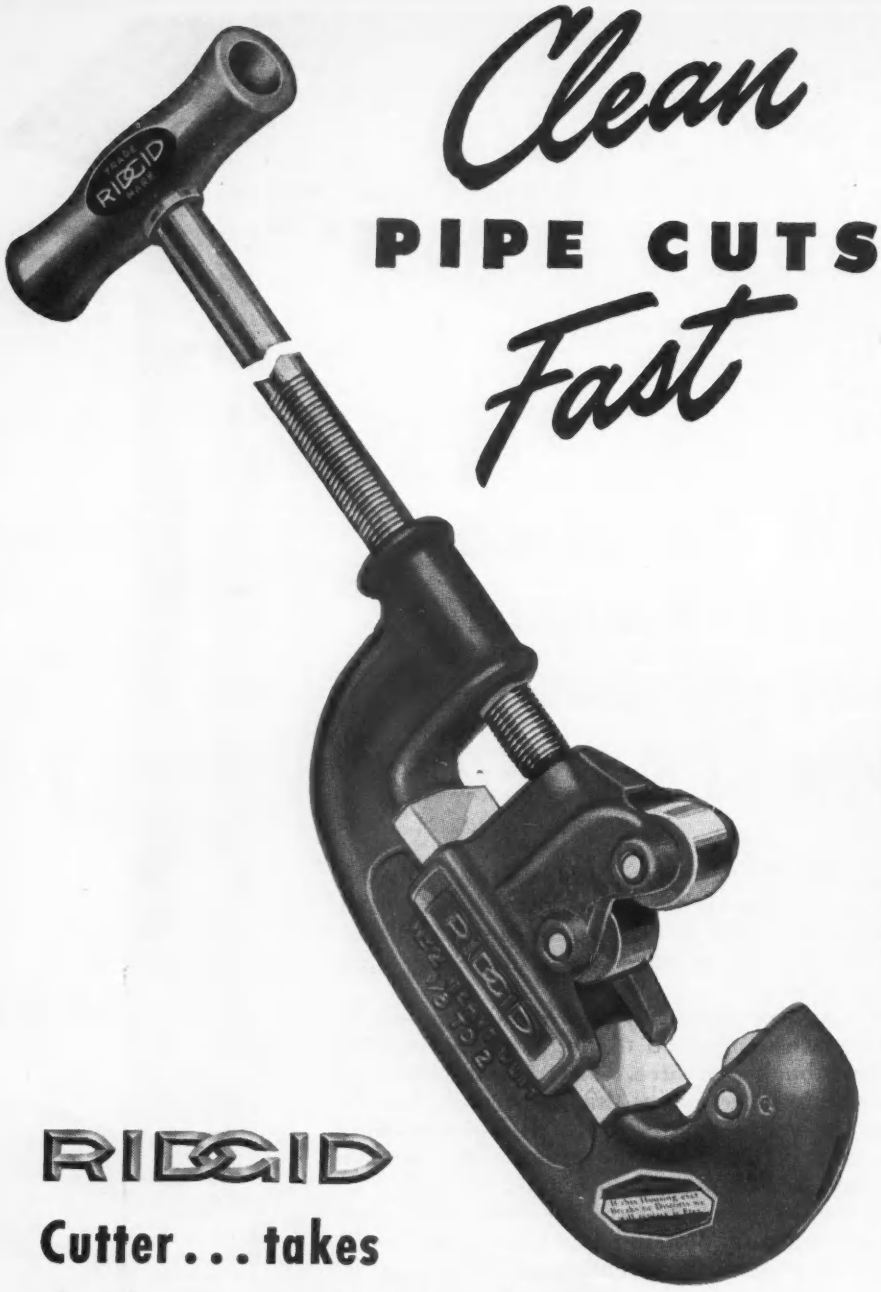

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PIPE CUTS
Fast

RIDGID
Cutter . . . takes
the hard work out of pipe cutting

● Efficiency-balanced for extra ease of work, RIDGID Cutter is a natural for fast clean cutting of all kinds of pipe and conduit. Special malleable frame won't warp — one-piece thin-blade tool-steel cutter wheels always track perfectly, leave practically no burr. Every cutter factory-tested. Your choice of 5 sizes to 6" pipe; also 4-wheel short handle cutters to 4" for tight quarters. For speedy cutting with least effort . . . buy RIDGID Cutters at your Supply House.

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WORK-SAVER PIPE TOOLS
THE RIDGE TOOL CO. • ELYRIA, OHIO

EQUIPMENT and SERVICE SUPPLIERS' NOTES

J. C. Ballagh Retires as Manager Of Patterson-Ballagh Division

J. C. Ballagh has resigned as vice president in charge of Patterson-Ballagh, division of Byron Jackson. Ballagh, who is a partner in Key Contractors, oil field construction company, is also president of Extruders, Inc., a plastic core container manufacturing company which he formed a year ago.

With Ballagh's resignation from Patterson-Ballagh, J. P. Magoffin, Mid-Continent sales manager since 1943, has been promoted to general sales manager. Before joining Patterson-Ballagh, Magoffin was with Hydril Company for 12 years as field representative. John B. Merritt will continue as assistant general manager of the division.

Graduated from Colorado School of Mines in 1910, Ballagh worked for about a year in mining in Mexico, then went to California and worked for a year in

J. C. Ballagh

J. P. Magoffin

the oil fields in San Joaquin Valley. For nine years he was in the oil and mining machinery business in El Paso, Texas. After working as a petroleum engineer at Breckenridge, Fort Worth and Wichita Falls, Texas, and El Dorado, Ark., he went to Oklahoma where he engaged in drilling.

Ballagh returned to California in 1923, and served for several years as a salesman with Layne and Bowler and Pomona Pump Company. In 1927, while with Johnston Pump Company, he met W. I. Bettis, pump designer who had a patent on a new type rubber protector that would prevent damage to casing by rotating drill pipe. With the assistance of C. L. Patterson, a friend of Ballagh and proprietor of a tire retread shop in Los Angeles, a rubber protector was developed to withstand the rough usage encountered in drilling operations. The business grew into the Patterson-Ballagh Company, which in 1946 was bought by Byron Jackson Company. Ballagh remained with the company as vice president in charge of Patterson-Ballagh division until his resignation.

Continental Will Distribute Ladish Company Equipment Line

The Ladish Company, Cudahy, Wis., has appointed Continental Supply Company as authorized distributor for its seamless welding fittings, forged steel flanges and forged steel fittings.

An adequate stock of the entire Ladish line will be carried by each of Continental's 70 stores and offices throughout the Mid-Continent, Gulf Coast and Rocky Mountain areas.

Fly

The Direct Route to

VENEZUELA - JAMAICA - CUBA

from

NEW ORLEANS and HOUSTON

The C & S "CARIBBEAN COMET" provides direct, one-carrier service to Venezuela and South America from the oil and industrial area of the Southwest. One-plane service to Caracas and Kingston. Non-stop service from Houston to Havana. Four flights weekly from both Houston and New Orleans by fast, four-motored Dixie-liners. Departures every Tuesday, Thursday, and Saturday afternoon.

Ask your travel agent, or

CHICAGO & SOUTHERN AIR LINES

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If you are

moving—

Tell us your new address ahead of time.

Only by notifying WORLD OIL at least three weeks in advance of your move, can you be assured of uninterrupted service.

WORLD OIL

(Established 1916 as The Oil Weekly)

P. O. BOX 2608 HOUSTON 1, TEXAS

Select High Alloy Steel

LONGHORN

TUBE JOINTS

Features:

1. Eliminate wear and tear on tubing threads
2. Save time on round trips
3. Prevent crushed tubing by tong action
4. Have full opening for bottom hole tools
5. Are 100% interchangeable

LONGHORN TUBE JOINTS save money in well completion and reworking operations because they permit varied use of tubing where expensive strings of drill pipe might otherwise be required.

Available in standard sizes. Others furnished to customer requirements. Special, all-metal skid mounted, protective carrying case can be furnished.

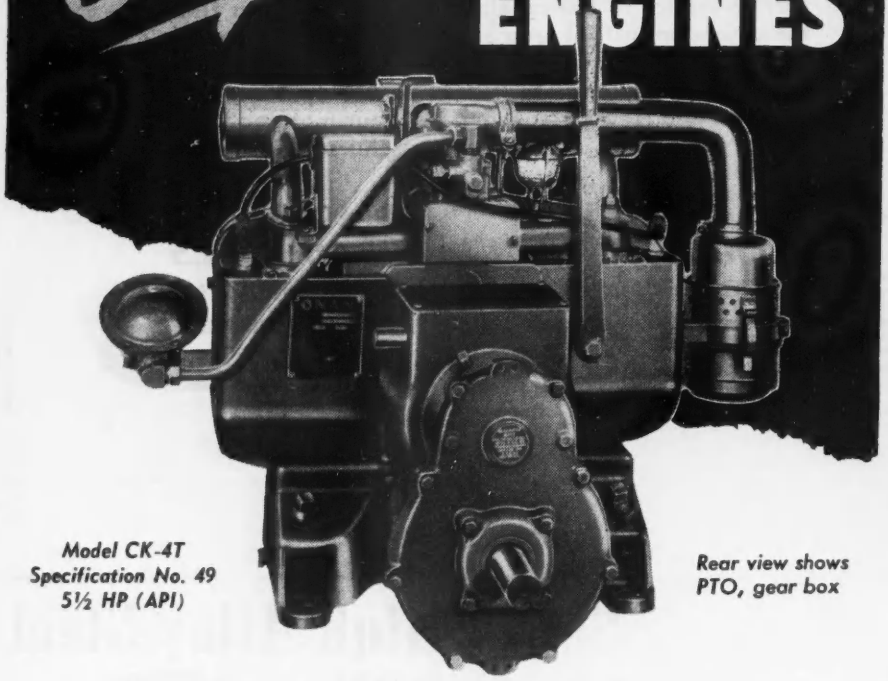
SOLD THROUGH YOUR SUPPLY STORE
Write for literature and price lists.

Longhorn **MACHINE WORKS**

6823 Navigation
Houston, Texas

Dallas Branch: 3901 Southwestern

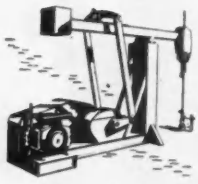
ONAN "CK" Oilfielder ENGINES



Model CK-4T
Specification No. 49
5½ HP (API)

Rear view shows PTO, gear box

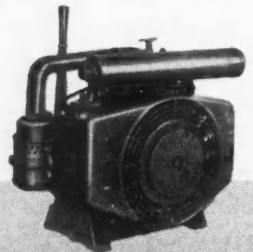
Built for Continuous Duty on Tough Pumping Jobs!



Do you have a job for a 5½ HP roughneck? Here's a dependable 1000-inch-pound torque engine that will do a job for you day-in and day-out with minimum maintenance and attention. No cooling problem because it's air-cooled. Little or no sludging. Has features of an engine many times its size. Smoother-running because of its twin-cylinder, horizontally-opposed design, the Onan "CK" Oilfielder gives lasting service on the toughest jobs.

Full pressure lubrication by gear-type oil pump. Runs on either gas or gasoline. Check with your supply house or write.

ONAN OILFIELDER ENGINE—*5½ HP.*
ONAN ELECTRIC PLANTS—*A.C.: 350 to 35,000 watts. D.C.: 750 to 15,000 watts. Gas-gasoline and Diesel models.*



1000-inch-pound torque • 5½ HP continuous duty (by API formula) • 960-ft. piston speed • 525 PTO shaft speed through 4.1 gear reduction • Over-center dry disc clutch • 4-quart oil sump • Air-cooled by large axial-flow blower.

D. W. ONAN & SONS INC.
5352 Royalston Ave. Minneapolis 5, Minn.

Onan PRODUCTS **ENGINES & ELECTRIC PLANTS**

RECORDS SET—**Drillers at Superior Oil Company's Limoneira No. 1 wildcat set records for rotary jarring with McCullough Tool Company jars.**

Rotary Jar Records Are Set in Superior's California Wildcat

Two records for rotary jarring were set by McCullough Tool Company, Los Angeles, in The Superior Oil Company's Limoneira No. 1 wildcat near Ventura, Calif. It was the first time a fish had been recovered from such a great depth, and the first time rotary jars had been employed in such a deep well.

The McCullough jars were used in the drill pipe string during drilling operations below 17,159 feet as a precautionary measure. A few minutes after the drill pipe became stuck at 18,136 feet, the four-inch rotary jars were in operation. The jars were in continuous operation for 22½ hours but due to the fact that drill collars were not used above the jars for additional weight the fish would not come loose.

To correct this, the safety joint below the jars was released and the drill pipe pulled from the hole. Nine, 6-inch, 40-foot drill collars were then put on above the jars and the complete assembly was lowered into position again and the safety joint was reengaged.

After 8½ hours of additional jarring the fish was successfully jarred loose and recovered.

Although the weight of the full string of drill pipe was 320,000 pounds the McCullough rotary jars were operated to jar at 400,000 pounds, and struck a blow every few seconds for over 31 hours.

SPECIAL TREATMENT
FOR EVERY PART

Boxed for your protection . . .
labeled for your convenience.

Not one, but several better alloy steels have been developed by Jeffrey in making side bars, pins and bushings for 'Devil Dog' chains (A.P.I. 3 and 4). Each part is individually heat treated and machined. Precision finish of parts eliminates the need for 'breaking-in'. Illustration shows the side bars going through the Shaker Hearth machine in our heat-treating department.

JEFFREY

ESTABLISHED 1877

THE JEFFREY MANUFACTURING COMPANY, 985 North Fourth Street, Columbus 16, Ohio

BUTLER BOLTED TANKS

ARE AVAILABLE NOW For Prompt Delivery

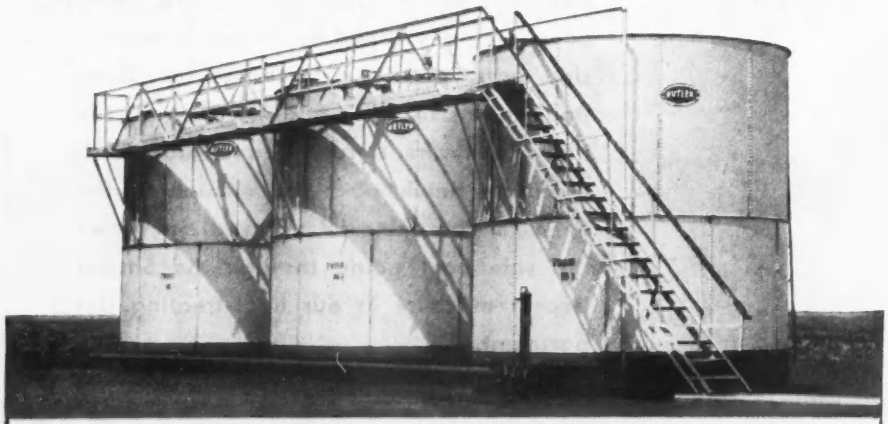
Here's good news for oil men everywhere! Larger supplies of top quality steel are available for bolted tank fabrication, and production lines at Butler are turning out more and more of these adaptable, long-life tanks.

For safe, oiltight storage, Butler Bolted Tanks have always been first in demand. Their ease of erection, speedy dismantling and reerection, and extra strength mean greater economy in oilfield use. Right now, Butler tanks are in good supply—and will continue to be as long as quality steel is available.

Butler oilfield organizations are ready to furnish you speedy, erection service in the field. Call the one nearest you today!

BUTLER MANUFACTURING COMPANY

Kansas City, Mo. Galesburg, Ill. Richmond, Calif. Minneapolis, Minn.



Call These Experts for Prompt Service

AMERICAN PIPE & SUPPLY CO.
Denver, and Rangely, Colo.
Casper, Wyo.
Cut Bank, Mont.

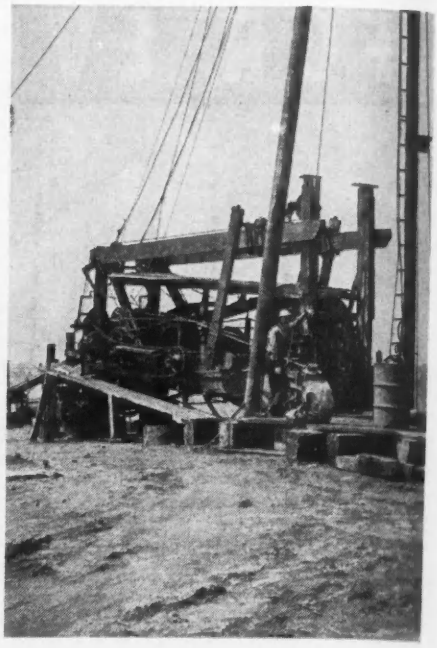
HARRY G. MILLER
El Dorado, Ark.

BUTLER

UNION TANK & SUPPLY CO.
Fort Worth, Houston, Odessa,
Alice, Tyler, Midland, Texas
Lafayette and Homer, La.
Great Bend, Kans.
Tulsa, Oklahoma City, Okla.
Hobbs, N.M., Jackson, Miss.

BOLTED TANKS • WALKWAYS • STAIRWAYS • UNIT HEATERS

EQUIPMENT and SERVICE SUPPLIERS' NOTES



USE SPUDDER 13 YEARS—M & M Drilling Company, Midland, Texas, has used this Wichita 61 spudder powered with a Model HP-601 Cummins Diesel for more than 13 years. M & M has drilled to 6000 feet with this rig.

Franks Vice President Becomes California Sales Representative

R. M. (Dick) White, vice president of Franks Manufacturing Corporation, Tulsa, has moved to California to become exclusive California representative for Franks. Until he selects a permanent office location, White will make his headquarters at the Franks service branch at 909 Alemeda Street, Compton.

R. M. White

White was formerly a roughneck with the Noble Drilling Company and rotary rig engineer for Oklahoma Iron Works. He joined Franks in 1934. White established the firm's first district office in Fort Worth, and was Washington representative during World War II.

Oil Tool Manufacturing Will Open Supply Store at Odessa in June

Oil Tool Manufacturing Company, Houston, will open a new store distribution point in Odessa, Texas, about June 1, to provide overnight service on oil field and industrial piping supplies to the West Texas, Southern Oklahoma, New Mexico and Colorado areas. The Odessa store will carry a complete stock of oilfield and industrial piping supplies.

J. Koetter, sales manager for the company, will visit the Odessa area in May to complete arrangements for the store opening.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Alex P. Smith

Harry S. Zane

Guiberson Corporation Promotes Two to Top Executive Posts

Top management changes in the Guiberson Corporation, Dallas, include the promotion of Alex P. Smith to executive vice president and general manager to assume direction of all company activities. For the past seven years, Smith has been treasurer of the corporation.

Harry S. Zane, Jr., purchasing manager for the past nine years, has been advanced to the position of general sales manager. Zane is now directing a training program for sales personnel, to acquaint them with factory manufacturing processes.

Cooper Sales Engineer Inspects South American Oil Operations

E. E. Everson, sales engineer for Fred E. Cooper, Inc., of Tulsa, will make an extended trip through the drilling and producing fields in South America. He will visit the fields in Peru, Ecuador, Venezuela and Colombia before returning to the U. S.

E. E. Everson

Everson has been with Cooper since 1939 and has been Northwestern divisional manager for the past year.

While in South America, Everson will study the application of and introduce heavy duty drilling and work-over units that have been added to the Cooper line since the last Oil Exposition.

Lane-Wells Opens Truck Station, Names Assistant Personnel Manager

Lane-Wells Company has opened a new truck station at 200 South Church Street, Jacksboro, Texas. R. W. Richardson will be the operator-in-charge. Facilities for perforating, radio-activity well logging, and setting of packers and drillable bridging plugs are available.

Hollis L. Barnard was appointed assistant personnel manager for Lane-Wells. Barnard was formerly assistant personnel director at the Rheem Manufacturing Company, Southgate, Calif. Prior to serving two years during World War II with the Naval Reserve, he was with the Stewart-Warner Corporation, Chicago, at a time-study engineer.

Star's "Rubber-Mount" design places 30 rubber mountings under the crown sheave (illustration below) and in the spudder. The spudder floats completely on rubber at all bearing points and sheaves.

The NEW No. 72 "Rubber-Mount" SPEED STAR . .

✔ NEW, PROVEN DESIGN
✔ NEW DRILLING ACTION
✔ NEW EARNING TOPS

. . . ONE OF A SERIES OF MODERN, • PROFIT-MAKING • DRILL RIGS BUILT BY A COMPANY 60 YEARS IN BUSINESS

ANOTHER "FIRST"—

Star's patented "Rubber-Mount" design, which gives full protection to the machine and develops a powerful drilling motion with terrific penetrating ability. The No. 72 Speed Star easily swings tools averaging 2500 lbs. on wells 6" to 16" diameter. It is ideal for the drilling and cleaning out of shallow wells.

Ask for Bulletin No. 72-B.

OTHER No. 72 FEATURES:

1. Star's famous balanced construction distributes load, eliminates side strain and prolongs life.
2. Double catheads are regular equipment, with friction clutch control for safety.
3. Extra large capacity masts with power hoists.
4. Three full-width reels, chain-driven, with friction clutch controls, provide flexibility for all operations.
5. 23 anti-friction bearings conserve power and lengthen service

Mountings: truck, full trailer, semi-trailer.

Now you can get this and other Speed Stars at greatly Reduced Prices!

"If it's a Speed Star, it's a Fast, Proven Money-Maker"

THE STAR DRILLING MACHINE COMPANY
475 WASHINGTON STREET • AKRON 11, OHIO
Drilling Machines and Tools Since 1889

Employes Share Firm's Profits

The Martin-Decker Corporation, Long Beach, Calif., headed by E. L. Decker, president and general manager, has inaugurated a profit-sharing plan which disburses 25 percent of the corporation's 1948 net earnings among employes on a formula basis for 1948, depending on length of service and salary. One-half of the fund was paid in December, 1948, and one-half is to be distributed June 30, 1949. Shown are Martin-Decker employes at a party where profit-sharing checks were distributed.

Employes of the firm, without the help of professional service, have completed a plant modernization program which embodies color treatment, decorative effects, and convenient layout.

Type "30-XV" King Swivel

The Answer to Many Requests

Be Sure IT'S A KING *Be Safe*

The type 30-XV King Swivel was designed particularly for rigs that are used for drilling large volume water wells, such as for municipal water works, industrial water supply and irrigation wells.

This swivel is intended for use where the pump pressure is relatively low, and the drill pipe is rotated at slow to moderate speeds. It is particularly suited for circulating the drilling fluid by means of centrifugal pumps, when reaming down for pit, where a deep well turbine pump is to be set. The extra fluid capacity permits circulation of enough mud to give sufficient velocity to the returns to prevent cuttings from settling back on the reamer.

Some of the features:

- 3" DIAMETER WATER COURSE assures Large Fluid Volume.
- A MOULDED RUBBER PACKING ELIMINATES the stuffing box.
- A HARDENED WEAR-BUSHING eliminates the washpipe.
- THE PACKING AND WEAR-BUSHING can be renewed within a very few minutes without removing any other part from the swivel.
- ANGULAR-CONTACT BALL BEARINGS provide ample thrust capacity and insure radial stability.
- ALLOY STEEL CONSTRUCTION assures safety with minimum weight.
- SHORT, COMPACT DESIGN requires less room in the derrick.
- STREAMLINED—no projections to "hang up."
- CLOSED HOUSING PROTECTS THE BEARINGS.
- LUBRICATION, of BEARINGS, is by means of a grease gun.

We sincerely believe this swivel will fulfill a long felt need of the water well drilling fraternity.

See the 1948 Composite Catalog for other products of King Oil Tools.

Order through your supply house.

KING OIL TOOLS

210 TERMINAL STREET PHONE W. 6-8013

HOUSTON 10, TEXAS

EXPORT: R. S. Stokvis & Sons, Inc.
17 Battery Place, New York 4, N. Y.

Silvacon Sales Establishes Offices in Texas and Oklahoma

Silvacon Sales of Weyerhaeuser Timber Company, Longview, Wash., has opened distribution in Houston and Odessa, Texas, and Lindsey, Okla. The new offices will distribute Silvacel, a wood fiber product for controlling lost circulation of oil well drilling materials.

Silvacel distributors with large available stocks are centrally located in the California, Rocky Mountain and Mid-Continent oil field areas.

Silvacel is used as a sealing agent to prevent loss of rotary drilling fluids in gravelly, fractured or fissured formations. When mixed with mud, the Douglas Fir wood fibers form a dense mat which serves as a protective lining over porous areas encountered as drilling progresses.

Compactly baled, Silvacel is easy to ship, handle and store. Entirely stable, it will not rot or otherwise deteriorate in storage or in use.

Literature and further technical details may be secured by writing to Technical Service, Silvacon Sales, Weyerhaeuser Timber Company, Longview, Wash.

Kobe Appoints Howard Sweet Manager of Coastal District

A member of the Kobe organization since 1945 and a district representative in the Los Angeles Basin area for the past six months, Howard Sweet has been promoted to manager of the Coastal district, with headquarters at Ventura, Calif. As field engineer for the California Technical Service section, he supervised the first two Free Pump installations made in the Rangely, Colo., field.

Howard Sweet

Sweet is a graduate of the University of Utah in mechanical engineering. His first job after graduation in 1935 was with the Durable Company as Western division manager. In 1941 he joined Calship as a production engineer, and from 1943 to 1945, he was a sales engineer for Lane-Wells Company.

Coordinator Appointed

Floyd E. Palmer has been appointed field and sales coordinator in the Rocky Mountain area for Mud Control Laboratories, Oklahoma City, with headquarters at Denver, Colo.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Edmonton Oil Equipment Sales Representative Is Appointed

Arch R. Boyd has been appointed joint sales representative at Edmonton, Alberta, for the Oil Tool division, Byron Jackson Company, and Patterson-Ballagh Division.

Arch R. Boyd

Boyd has worked as roughneck and driller for several Canadian contractors and operators. During World War II he served in the Royal Canadian Navy.

He will handle sales and service of Byron Jackson and Patterson - Ballagh equipment after completing a training tour of the main factories and visiting the oil fields of California, Texas, and the Rocky Mountains to study technique.

Halliburton Company Is Licensed For Stanolind Hydrafrac Process

Stanolind Oil and Gas Company has licensed Halliburton Oil Well Cementing Company of Duncan, Okla., to service wells with the Hydrafrac process developed by Stanolind. The process is designed to increase oil or gas production by fracturing the productive formations, thus making it easier for oil or gas to flow through the formations to the wells.

Halliburton has been given an exclusive license for at least two years. In addition, Halliburton has the right to license operators in certain foreign countries to use the process on a commercial basis.

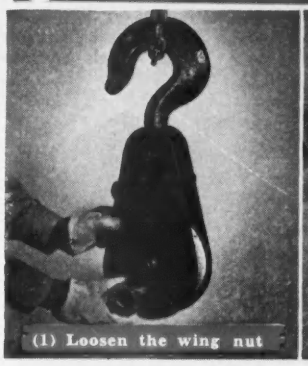
The process was developed at the Stanolind research laboratories and was first announced at the meeting of the American Institute of Mining and Metallurgical Engineers in Dallas last October.

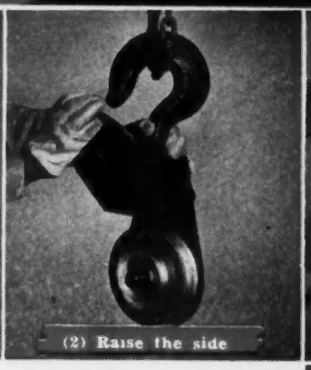
Hydrafrac, which gets its name from the fact that it is a process for the hydraulic fracturing of underground formations, uses a viscous liquid, such as jellied gasoline or jellied light crude oil, in the process. This liquid is pumped into the well under very high pressure; it splits the oil-bearing formations and opens cracks through which the oil can flow to the well-holes. Sand may be suspended in the fluid to help keep the cracks from closing by acting as a prop within the fracture.

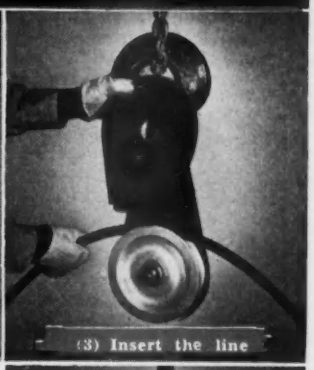
After the rocks have been split, a liquid chemical may be pumped into the well. This chemical accelerates breaking the fracturing fluid into a thin liquid thus allowing it to flow out of the well with the oil being produced.

Hydrafrac may aid production by rejuvenating old wells; by decreasing the number of wells that need to be drilled to drain a field; by bringing in production in new fields where rocks are so "tight" that oil could not otherwise be produced; and by selectively fracturing the tighter zones in both injection and producing wells in secondary recovery programs.

It's Surprising

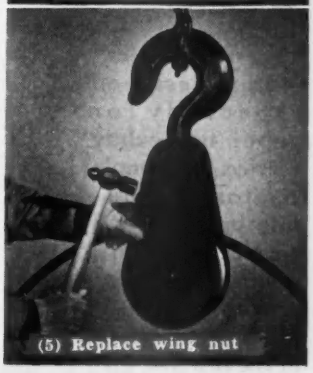

(1) Loosen the wing nut


(2) Raise the side


(3) Insert the line

How Fast and Easy You Can String a WECO Snatch Block

(4) Drop the side


(5) Replace wing nut

When you're working with a WECO Block, you string or unstring it easily and quickly at any time, whether or not there's weight on the line. There's no trick manipulation, no "wrestling" to release or secure the side . . . you simply unscrew a nut, lift the plate, insert or remove the line, drop the plate and secure the nut. All weight is held on the sheave and the entire block remains rigid and in position throughout the operation. There's never any need, of course, for the *end* of the line.

Other WECO features . . . full swiveling forged steel hook, heavy shell plates, forged sheave with accurately gaged, rope-saving groove, heavy hardened and ground sheave pin, "Super Oilite" bushing . . . combine with the time-saving drop side to make WECO Snatch Blocks the finest available. Specify them for the ultimate in speed, safety and service. Available with full swiveling hook or clevis.

SOLD THROUGH SUPPLY STORES EVERYWHERE

YOUR WECO REPRESENTATIVE can furnish you with helpful information on the use and care of snatch blocks and wire lines. Applied in your operations, this information will effect great savings in time and materials.

WELL EQUIPMENT MFG. CORP.
Subsidiary of Chiksan Company
Houston 1, Texas
Exclusive Sales Representative Outside Mid-Continent Area
CHIKSAN COMPANY
Brea, Calif. New York 7
Export Sales: CHIKSAN EXPORT COMPANY, Brea, Calif. New York 7

WECO
Manufacturers and Distributors of Oilfield, Refining, Marine and Industrial Equipment

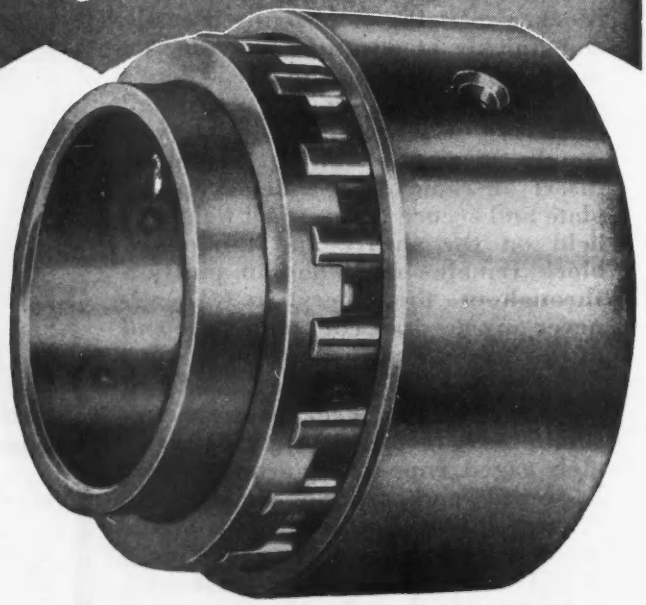
LARKIN SALES MEETING—Shown are members of the sales organization of Larkin Packer Company, Inc., who attended the company's annual sales meeting in St. Louis. Left to right, they are J. A. Hill, Houston; E. D. Curran, Lyons; R. G. Fones, Jennings; G. F. Robinson, Ardmore; W. Ford, Mt. Vernon; F. E. Stevens, Laurel; S. W. Robinson, Houston; T. E. Alexander, Houston; I. P. Allen, Oklahoma City; W. H. Larkin, St. Louis; H. V. Flemming, Tulsa; Dorothy Wilhelm, St. Louis; A. Hokey, Corpus Christi; J. J. Larkin, Jr., St. Louis; R. B. Miller, Liberal; C. F. Warner, Los Angeles; J. B. Hendrix, Odessa; J. C. Green, Shreveport; L. E. Vessels, Wichita Falls; F. S. Dewel, Casper; and C. Cardinal, Lovell.

American

"Extra" Heavy-Duty

Roller Bearings

for the toughest anti-Friction jobs



Here is a "super" bearing designed especially for super heavy-duty service. Its simple construction, absolute precision and tremendous strength assure smooth, dependable performance in the heaviest machinery under the most difficult operating conditions. Complete technical data furnished without obligation. Write.

AMERICAN ROLLER BEARING CO.

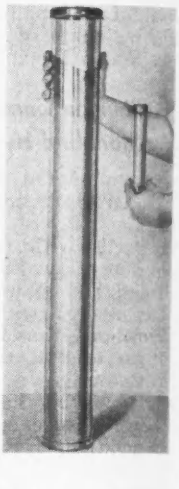
420 Melwood Street Pittsburgh, Pa.

AMERICAN ROLLER BEARINGS

Pacific Coast Office: 1718 S. Flower St., Los Angeles, Calif.

Mid-Continent, Rocky Mountain Core Tube Distributor Named

The complete line of Extrulite Core Tubes for protecting, storing and transporting conventional oil well cores is now available in the Mid-Continent and Rocky Mountain branches of the Reed Roller Bit Company. Extrulite Core Tubes are manufactured by Extruders, Inc., of Culver City, Calif.



The light weight plastic tubes eliminate the possibility of mixing or reversing samples, as all pertinent data is inserted on a label which is visible from the outside of the tube. As the cap sealed at the well is red, orientation of the sample is simplified. The other end of the tube is clear, and factory sealed. Solvent to provide an air-tight seal is available.

Tube diameters range from one to 4½ inches and standard length for storing purposes is 36 inches. Sidewall core tubes measuring 1⅜ inches by seven inches are stocked. Light weight metal and plastic carrying cases are available.

New General Manager Appointed For Rockwell Pittsburgh Division

Ralph G. Caouette has been appointed general manager of the Pittsburgh Equitable Meter Division of Rockwell Manufacturing Company.

Ralph G. Caouette

Caouette was production superintendent of the Delta division before moving to Pittsburgh. Later he became manager of Industrial Engineering for all Rockwell plants, and general manager of the Red Star Products division at Norwalk, O. Before joining Rockwell, Caouette was industrial engineer for Minneapolis-Moline Implement Company at Moline, Ill.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Western Company Adds Jet Services; R. B. McCullar Joins Sales Staff

The Western Company of Midland, Texas, is now equipped to provide jet casing perforating and jet formation shooting to the Permian Basin oil industry. Commercial names of the new services are Western "Pipe-Jet" Casing Perforating and Western "Pay-Jet" Formation Shooting. Both services are based on the jet-charge principle and use the new "shaped charge" manufactured by Dupont.

R. B. McCullar

John F. Younger, manager of Western's perforating department, has returned to Midland from the Dupont Laboratories in Wilmington, Del., where he conferred with the manufacturers and furnished them with first-hand information on the action of the charges in the field.

R. B. (Luke) McCullar has joined the sales staff to specialize in selling the company's acidizing service, as well as the bullet and jet-charge casing perforating and jet formation shooting.

From 1936 until 1948, McCullar was manager of the Mid-Continent division of Lane-Wells Company in Oklahoma City, in charge of operations in North Texas, the Texas Panhandle, Oklahoma, Kansas, Rocky Mountains, and the Illinois Basin.

McCullar worked as a roustabout and roughneck during summer vacations while attending the University of Oklahoma, from which he was graduated with a geological engineering degree in 1931.

Rockwell Manufacturing Appoints Bygate Assistant Vice President

C. S. Bygate has been appointed assistant vice president of the meter and valve divisions of Rockwell Manufacturing Company. Bygate, who joined Rockwell in 1943, started in the Pittsburgh Equitable Meter Division and later transferred to General Purchasing, where he correlated the buying habits of Rockwell's 17 divisions and subsidiaries.

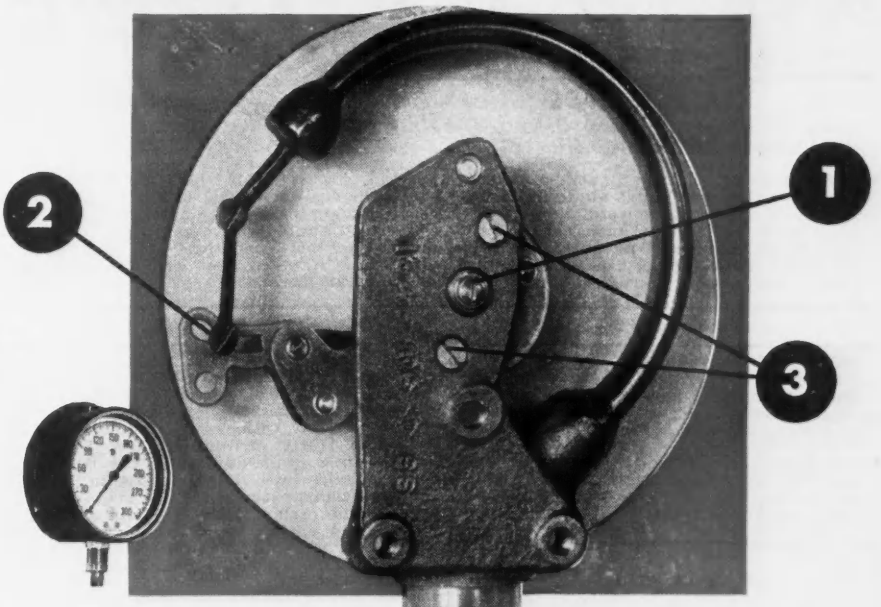
C. S. Bygate

Bygate attended Franklin and Marshall College and was with Stone & Webster Engineering Corporation before he joined Rockwell.

Hodnett Joins Geophysicists

W. H. Hodnett has joined and been elected president of Crowell & Steel, Inc., Houston geophysical firm. Hodnett previously headed the Atatl Royalty Corporation.

EASIEST GAGE TO CALIBRATE

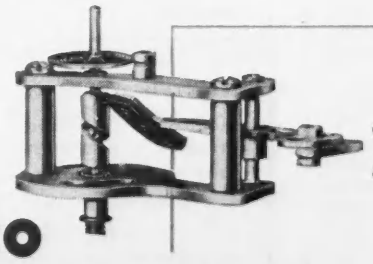


So says the Instrument Engineer

Here's Why: The external pointer set (1) is handy and very useful. In no other gage can the pointer be set without removing the glass and ring. Often a HELICOID gage can be made accurate simply by resetting the pointer.

If recalibration is necessary, the complete gage system is removed from the case. But there is no need to remove the pointer or dial. All adjustments are conveniently at the rear. For pointer travel, the link screw (2) is moved inward or outward in the cam slot. For scale linearity the movement is rotated by loosening screws (3). All this can be done *quickly* with a Helicoid gage. When recalibrating other gages, the pointer and dial must be removed frequently until calibration is attained. This takes more time and costs money.

The HELICOID gage is the easiest to calibrate and the easiest to keep in calibration.



Only Helicoid Pressure Gages have the Helicoid Movement

ACCO

TRADE MARK

HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE
Bridgeport 2, Connecticut

WORLD OIL'S Trading Post

CLASSIFIED ADS

SERVICES · PERSONNEL · USED EQUIPMENT

RATES: Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas.

FOR SALE

■ WELL drilling spudders, beams, light rotaries, core drills, tools and casing. Used equipment at money saving prices. Spang and Mills new tools. Leschen lines. Everything for well drilling. Pressey & Son, Pueblo, Colo.

■ Completely reconditioned 6 cylinder 7x8½ Atlas Imperial Diesel Engine, $8,500. Southwest Drilling Co., 209 Petroleum Bldg., Fort Worth, Telephone 2-9291.

FOR SALE

3½" and 4½" good used Drill Pipe and Tool Joints for drilling purposes, at reasonable prices.

THE NATIONAL SUPPLY COMPANY
FORT WORTH, TEXAS

FOR SALE

ONE No. 10 UNIT RIG DRAWWORKS with Two D13000 Caterpillar Diesel Engines Compounded. Equipment in good shape. KIOWA DRILLING COMPANY, INC., 717 Union National Bank Building, Wichita 2, Kansas. Phone 3-8013.

11 NEW 24" Merco Nordstrom Figure No. 4449 Gear Operated Lubricated Plug Valves, with Series No. 40 Flanged Ends. Test 810 lbs. at 100° F. Utilities & Industrial Supply Company, 921 Michigan Avenue, Jackson, Michigan.

It's New... Check It!

PIPE GRINDING MACHINE designed and built to give pipe line contractors maximum service in polishing the bevel on plain end pipe in preparation for welding. The machine can be placed on pipe easily and quickly, and will clean the bevel on 24-inch pipe in 15 seconds, whereas a man with file would have to work at least 15 minutes. The grinder is constructed for durability, light weight, effectiveness and economy. Electrically driven, it may be operated from electric welding machines on the line.

The Machine was perfected, and now being manufactured by

WICHITA TOOL REPAIR CO.
of Wichita Falls, Texas
Under license from O. R. Hall, inventor

FOR SALE

■ 25 STRINGS CABLE DRILLING TOOLS, everything to drill with, 60 stems, bits, bailers, jars, fishing tools at half price or less; 3—6x80 Parkersburg and Ideco heavy rigs, calf wheels, OCS sand reels, $2,500 each. 3—Riis 170HP. drilling engines, $3,200 each. 20—3-inch pumping rigs complete, belts, tanks, wire lines. 10,000 ft. 5½ in. 13 lb. lap weld casing, .82c. 20,000 ft. 7 in. OD. 17 lb. lap weld casing. $1.10. 8 ⅝ths and 10 inch lap weld casing. 20,000 ft. 2 ⅜ths in. 4.60 wt. lap weld upset used tubing, .28c. TRI STATE OIL AND GAS CO., Box 827, Parkersburg, West Va.

FOR SALE

1—Model K. Cardwell Double Drum Drawworks with rotary table drive and transmission assembly, American cathead.
2—D13,000 Caterpillar engines.
1—Type FE 12½" National Rotary Table.
1—3½" Kelly.
2—3½" Drill Collars.
Misc. 3½" Drill pipe slips, Kelly bushings, and drill pipe subs, all in first class condition located our McPherson, Kansas yard.

VEEDER SUPPLY & DEVELOPMENT COMPANY
Cherryvale, Kansas

HELP WANTED

Old and established manufacturer of oil well production equipment wants full time representative for Gulf Coast territory with headquarters in Houston. Salary, traveling expenses and car allowance. Require high class man. State age, experience, married or single and give references. Address: Box 19W, c/o World Oil, Houston, Texas.

Bolted steel tank company wants young man from 25 to 40 years in age with engineering education and production experience. Want a man that is aggressive, ambitious and able to meet the trade. An excellent future. He will be located in Southern Louisiana. Address: Box 22-W, c/o World Oil, Houston, Texas.

WANTED—Kansas Independent Refiner has opening for young, aggressive salesman refined products tank car and tank truck delivery to Mid-Western markets. Must be familiar with refining operations and equipment using products, especially diesel engines and home burners. Give age, experience and references. All our employees know of this ad. Address: Box 21-W, c/o World Oil, Houston, Texas.

HELP WANTED

■ WANTED—Geologist with at least six years' well completion experience in Texas Gulf Coast area. Address: Box 6, c/o World Oil, Houston, Texas.

SALES ENGINEER

Diesel engine distributor on Louisiana Gulf Coast needs young, experienced salesman to contact major companies, supply houses and contractors. Write stating qualifications.

GEORGE ENGINE CO., INC.
GM Diesel Distributor
P.O. Box 10054, New Orleans, La.

PETROLEUM SALES EXECUTIVE: Large midwest independent has immediate opening for experienced bright stocks and neutrals sales executive. Unusual opportunity. In replying give full information stating age, education, experience, salary required. Replies will be held confidential. Address: Box 8W, c/o World Oil, Houston, Texas.

ENGINEER: Midwest independent operating four refineries producing light oils, lubes, waxes and asphalts requires engineer with a minimum of 10 years refinery process and engineering design. Should be capable of carrying projects from economic study through process calculation, equipment design, and operating technique. Future for right man excellent. Give full particulars in first letter. Replies held confidential. Address: Box 4W, c/o World Oil, Houston, Texas.

WANTED TO BUY

EQUIPMENT WANTED

■ Am interested in purchasing good second-hand, unit 15 rig, with either 2 or 3 motor compound. Please send description, price and location to Makin Drilling Company, Box 131, Hobbs, New Mexico.

SITUATIONS WANTED

■ Position wanted with large independent producer, who is doing own drilling, or with progressive drilling contractor as drilling Engineer or Superintendent. Have fifteen years experience in various phases of drilling and engineering including directional drilling, mud engineer, formation testing, electrical and mud logging. Couple hundred hours as private pilot. Capable of handling and planning drilling costs. Thirty-nine years old, married, sober. Will furnish excellent references. Minimum starting salary considered $7200.00 annually. Address: Box 9W, c/o World Oil, Houston, Texas.

■ Experienced operator can handle part time lease and royalty buying accounts in Gulf Coast States. Box 15W, c/o World Oil, Houston, Texas.

■ Geologist-Geophysicist, 6 years foreign experience, exploration and subsurface. Also military research and university experience. Intimate knowledge of life and conditions abroad. Seeks foreign assignment. Available June. Address: Box 20W, c/o World Oil, Houston, Texas.

New Books and Maps

Central Texas Geology

University of Texas Publication 4621, "The Ellenburger Group of Central Texas," by P. E. Cloud, Jr., and V. E. Barnes, is a 473-page report of a geological investigation made cooperatively by the Bureau of Economic Geology of the University of Texas and the U. S. Geological Survey.

The monograph treats of correlation with the rocks of other regions, including the Ozark region, Arbuckle and Wichita Mountains in Oklahoma, Marathon basin, Sierra Diablo region, Hueco Mountains, Franklin Mountains, and others. In addition to the general and regional studies of the Central Texas area as a whole, nine areas are described in detail with measured sections and maps. Strata immediately above and below the Ellenburger are also considered in the report. Included also are descriptions of the economic resources of the Ellenburger strata.

Bureau of Economic Geology, The University of Texas, University Station, Box B, Austin 12, Texas, $6.00 (clothbound edition).

Natural Gas Investigation

Docket No. G-580 is a report on the Natural Gas Investigation of the Federal Power Commission.

Separate reports on the investigation were transmitted to Congress by Commissioners Nelson Lee Smith and Harrington Wimberly, and by Commissioners Leland Olds and Claude L. Draper. The two reports are being printed in separate volumes.

Superintendent of Documents, Government Printing Office, Washington 25, D. C., Olds-Draper report—40 cents. Smith-Wimberly report, $1.50.

Design for Welding

"Design for Welding" records the progress of arc welding throughout all industries during the postwar years, and is composed of abstracts of 82 award papers in the recent Foundation "Design-for-Progress" Award Program. Papers were edited and selected by Prof. R. S. Green, acting chairman of the Department of Welding Engineering for Ohio State University, Columbus.

The purpose of the book is to make available a record of representative welded designs. Professor Green has emphasized projects produced and put into operation to provide engineers and technicians in industry with a variety of ideas adaptable to their own products or structures.

The book contains cost data on the designs, affording a means of making a comparative study of methods.

Papers included are in the following categories: aircraft, automotive, railroad, watercraft, containers, furniture, structures, machinery and welderies. The book contains more than 100 pages of text material, illustrated with photographs, drawings, tables, as well as cost data.

The James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio, $2, postage prepaid in U. S., $2.50 outside of U. S.

API Codes

A new production publication, API RP 31, sponsored by the Topical Committee on Production Technology, has as its purpose adequate and uniform reporting of the minimum data that should accompany each electrical log to facilitate the correct interpretation and use of the log.

Another publication, API CODE 32, is the result of several years intensive study by the Special Sub-Committee on Oil Well Cements of the Topical Committee on Materials. Information and technical data were gathered from the petroleum industry, the cement industry, the American Society for Testing Materials and other organizations in formulating the code.

The code is a specification governing test procedures, methods and equipment which are used to evaluate and define those physical properties of cements of special importance to the oil and gas industry.

American Petroleum Institute, Division of Production, 1205 Continental Building, Dallas.

Flow Meter Handbook

The accuracy of the center-line velocity and pipe-factor method of applying the Pitot tube, described in "Principles and Practice of Flow Meter Engineering," is confirmed by recent tests made by professors Folsom and Iverson, of the University of California. The author of the handbook, L. K. Spink, points out, however, that to hold the expected error within plus or minus three percent, in addition to the precautions recommended by Folsom and Iverson, the Pitot tube, unless of an approved laboratory design, should be individually calibrated.

Pipe factors plotted in the handbook correspond closely to values given for 16-inch commercial iron pipe approximately ten years old, or for newer pipe in the smaller sizes.

The Foxboro Company, Foxboro, Mass., $3.

NOTICES

■ LEASE AND ROYALTY BUYERS always available for order buying in Louisiana and nearby states; write Original Leasing Service, Box 1606, Alexandria, Louisiana.

■ KANSAS OPERATOR, MAJOR COMPANY EXPERIENCE LAND DEPARTMENT, WILL ACT AS AGENT CAPITAL SEEKING OIL INVESTMENT. Address: Box 10W, c/o World Oil, Houston, Texas.

RESEARCH METALLURGIST seeks aid in the further development of his new continuous method for forming seamless steel pipe. The new method is applicable to oil well casing and pipe line sizes. Patents pending. Address: Box 18W, c/o World Oil, Houston, Texas.

I desire to contact financiers who are interested in forming a company to engage in the drilling, producing, and marketing of crude oil, natural gas, and gas distillate.

A company organized since the end of World War II has paid millions in dividends to its stockholders. This company obtained its facilities for transporting natural gas from the South and Southwest to the industrial East from the War Assets Administration.

Another company just recently organized, with headquarters in Houston, Texas, expects to begin its $190 million project in May with completion scheduled for 1951. Pipe shipments for this line are being received daily and stockpiled along the way from Texas to New York Harbor.

Since these and other transmission companies are making natural gas available to industrial areas, it has become one of the most valuable resources of the Southwest.

We will have available for our use the oil and gas industries' most competent and qualified personnel.

I am 39 years of age, have spent most of my life in the oil business, am thoroughly familiar with all phases of the industry, am a partner in a business closely associated with oil and gas, and served with the Army Air Force during the last war. You are at liberty to investigate me thoroughly.

Sufficient data to substantiate your financial ability must be given in your first letter; any information will be kept in strict confidence. If adequate capital is not assured to carry on the operations of this company, it will not be organized.

Attorneys will be appointed to draw up, or approve the laws and by-laws for the protection of all concerned. A meeting with those selected to become a part of this company will be arranged at a convenient time and place. Upon receipt of your letter indicating your interest, detailed information will be sent you. Address: Box 23W, c/o World Oil, Houston, Texas.

LEASES, DRILLING, ACREAGE, ETC.

■ SEE A. L. BOWLES, ADA, OKLAHOMA, FOR SHALLOW DRILLING DEALS IN OKLAHOMA.

■ We will buy producing or non-producing oil royalties. Send particulars. Standard Security Co., 115 Broadway, New York 6.

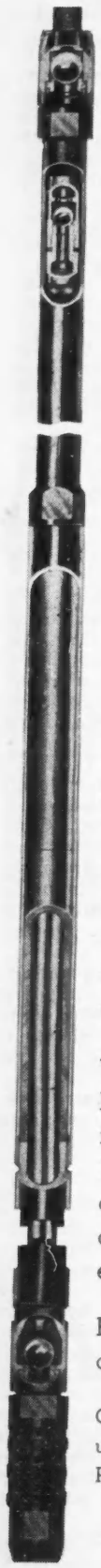
ROYALTIES IN HOT AREAS!

■ Recent strikes have focused attention on Montana's deeper oil zones and major companies are moving in fast, drilling and leasing. We buy direct in the field, sell direct to our customers. Write LANDOWNERS ROYALTIES COMPANY, Box 1225, Great Falls, Montana.

■ Prospective new shallow, high gravity oil field. N. W. Ga. Mississippian-Devonian shale and limestone exposures. Good structural indications. Drilling deals considered. Dietzen, Rt. 3, St. Elmo, Tenn.

To operators: We will sell or deal, up to 1,000 acres proven for 40 gravity oil by structural position and electric log, at 2400 feet depth. Wells 30 to 100 barrels per day. Cost $11,000 to "see the sand". Market by either of two interstate pipeline carriers. All usually needed casing furnished at cost or on oil payment if desired. We will operate for you, if desired. Address: Box 16W, c/o World Oil, Houston, Texas.

THE GREEKS GAVE US A NAME FOR IT



Mercury was the Greek god of commerce and gain, but another Mercury is called upon when oil producers want to secure more profit from their small wells--the O'Bannon **Mercury** Rod Pump.

A precision metal-to-metal pump, with 1" bore, the Mercury is made in three types: traveling barrel type; (illustrated) stationary barrel type with top hold-down; and stationary barrel type with bottom hold-down. Three lengths are available: 6', 8', and 10'.

PLUNGER—1 piece, Cro-Lay, which resists abrasion. Low friction of Cro-Lay reduces power costs.

BARREL—Alloy cast iron liners, heat-treated for wear resistance. Only 2 needed for shallow wells and 3 for deeper wells.

VALVES—Chromalloy balls and seats; 1¾" size in upper and lower valves, 1-1/16" size in "gas valve" on plunger. Anti-Mag cage on upper valve reduces effect of lodestone.

Repairs are easy to make and inexpensive.

Get more for your money by using O'Bannon Mercury Pumps in your small wells.

SOLD BY SUPPLY STORES

WALTER O'BANNON CO.
Tulsa 1, Oklahoma

SQUEAKS from the BULLWHEEL

Room Service

A lease broker staggered up to a hotel desk late one night and demanded another room. "But you have the best room in the house, sir," answered the clerk.

"I don't care," was the stubborn answer. "I want another room, and I want it quick."

Realizing that it would do no good to argue or reason with him any further, the clerk turned to the bellboy and said: "Move this gentleman out of 505 and put him in 508, right away."

Completely satisfied, the inebriated guest moved toward the elevator, offering no word of explanation or thanks.

"Would you mind telling me, sir, why you don't like 505?" asked the clerk, hardly expecting a sensible answer. He got one, however.

"The damn thing's on fire."

Case History

The doctor was questioning the new nurse about a patient.

"Have you kept a chart on his progress?"

"No, but I can show you my diary."

Which Way Did He Go?

"Don't be discouraged, Lulabelle. In this world there's a man for every woman. It's a wonderful arrangement."

"I know, mother. I don't want to change it. I just want to get in on it."

Nobody's Perfect

A bachelor met a girl at a dinner party and fell in love with her at first sight. During the course of the evening he was staggered by the extent and variety of her many accomplishments. Obviously she was the girl of his or anybody else's dreams, and he told her so in detail all the way home in the taxi. At her door, just before bidding her good-night, he took her key and opened the door for her. There, in her living room, was a dead horse. The man stared at it aghast. "Well," said the girl of many virtues and accomplishments, "I didn't say I was neat, did I?"

"Sometimes I wish the boss wouldn't take the employe suggestions so literally."

A Smile Is Her Umbrella

We know a guy who is so tight he won't buy his girl a beach umbrella when they lie on the sand. Instead, he tells her shady stories.

Ambitious Type

"Hello, Beautiful. I understand you are no longer a struggling steno."

"No. When I quit struggling I found I didn't need to be a steno."

Wrong Capacity

A fellow at a bar watched a girl come in and drink four Manhattan cocktails with no apparent effect. His curiosity getting the better of him, he leaned over and asked, "Would five make you dizzy?"

She replied, "The price is right, but the name is Daisy."

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Welding Saddles

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IMMEDIATE DELIVERY
OUTLET (OR NOZZLE) SIZES ¼" TO 16"
HEADER (OR LINE) SIZES UP TO 36"
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PELICAN WELL TOOL & SUPPLY CO.
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McCullough

GOES ANYWHERE—ANY TIME TO DO

YOUR FISHING JOBS

with the

FINEST FISHING TOOLS

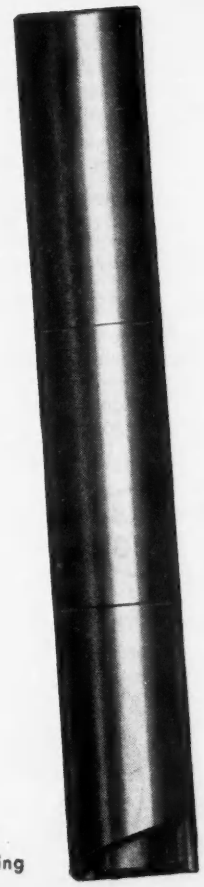
•

POSITIVE KNOWLEDGE
of just where pipe is stuck, and

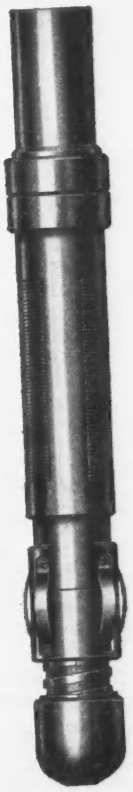
•

THOROUGHLY EXPERIENCED MEN

Double-Acting
ROTARY JAR
Strikes Blows Both
UP and DOWN



Rotary Releasing
SOCKET



Rotary
Releasing
SPEAR

Self-
Feeding
EXTERNAL
CASING
CUTTER

BUMPER
SUB

The
MAGNA-
TECTOR
shows just
where pipe
is stuck

Long Knife
Internal
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CUTTER

McCullough TOOL COMPANY
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MONTANA: Cut Bank
LOUISIANA: Houma, Lake Charles, New Iberia, Shreveport
WYOMING: Casper

EXPORT OFFICE: 30 Rockefeller Plaza, New York 20, N. Y.

Flashes from the BEACON

DID YOU MISS the stories of Denver and Houston? They appeared in recent issues of the BS&B BEACON, America's most widely-discussed industrial publication . . . Kansas City's next. Good old Cowtown, U. S. A., in all its elbowing bustle, color, and industrial growth, will be the feature-city of the June issue. Staff artists Galeland Blomdahl and David Hunt add their impressions to picture-stories you'll want to clip and keep.

* * *

"Hair and fingernails should be trimmed—not friends," says "Pop" Kenyon in his OBSERVATIONS, a page of wise commentary laced with humor. "Pop's" OBSERVATIONS have appeared in every edition of the BS&B BEACON, and have attracted correspondence from here, there, and everywhere.

* * *

Whoever heard of using a bolted tank for a filling station? . . . Why, BEACON readers! On a recent trip through Oklahoma and Texas, Special Products Sales Manager Bert Huff snapped pictures of BS&B tanks doing duty in a score of ingenious ways. Watch for more of 'em.

* * *

America's full of the most interesting people! The BS&B BEACON is focusing on folk groups which have come through the "melting pot" with much of their native ore as pure as ever . . . The "Pennsylvania Dutch" were first, their homespun, thrifty habits told with charm by Ray Winningham. "Cajun Country," second in the series, will appear in June together with photographs taken this spring by Frank Carder.

* * *

The BS&B BEACON is mailed regularly, without charge, to those who enjoy it. A request on your company letterhead will start the BS&B BEACON coming your way.

Write to:

BLACK, SIVALLS & BRYSON, INC.

Industrial and Public Relations Division
720 Delaware
Kansas City, Missouri

SQUEAKS from the BULLWHEEL

On Second Thought

"I'll bet you think twice before leaving that wife of yours alone for an evening. Am I right?"

"I'll say. First I have to think up an excuse for going out, and then a reason why she can't come."

Bravo!

The young country boy took sick and was rushed to the Charity Ward of a hospital. The case was pronounced as acute appendicitis. They filled him full of dope and passed him out.

When the youngster woke up, he pushed the button and when the nurse answered his call, he said, "Nurse, I hurt down here."

The nurse said, "Of course you hurt because you have just had your appendix taken out."

He said, "No, not there, down here."

Then the nurse said, "Oh, I should have told you—you are a very lucky young man. Tonight, our hospital was honored with the presence of a famous Viennese surgeon who holds the world record for appendectomies. He announced to everyone in the auditorium that he would set a new world's record, so when the timers were all set and the movie camera was focused, the doctor said 'Go,' and whacked away and in practically nothing flat the operation was over. Sure enough, he had set a new record for appendectomies and to a man, the crowd rose to its feet to acclaim the achievement. No wonder you hurt down there because after the crowd cheered and cheered and would not be quieted, he had to give you a circumcision for an encore."

Next Question, Please

A man was filling out a job application blank and came to the question: "Have you ever been arrested?" His answer was "No." The next question was, "Why?", and was meant for those who answered in the affirmative. Nevertheless he answered it with, "Never got caught."

Shrewd Move

"I got up at dawn just to see the sun rise."

"Well, you couldn't have picked a better time."

Is That What You Said?

"Did you follow my advice about kissing women when they least expect it?"

"Oh, darn," said the one with the swollen eye. "I didn't know you said when; I thought you said where."